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The Institute of British Foundrymen

The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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Progress

It was reported in our last issue that the adjourned annual general meeting of the Institute of British Foundrymen had endorsed the recommendations of its Organisation Committee, and that as a result the Privy Council are to be petitioned to sanction alterations in the rules. These changes are extremely important, but are evolutionary not revolutionary in character. Provision is made for a higher rate of subscription from the full member class, but for the youngsters and the operative the fees are less. The most important steps taken are those which tend towards making the Institute a "qualifying body"—that is, that entrance will be either by examination or through the holding of a position of such responsibility that suitability in every way can be assumed. Qualifying institutes by their very nature bestow upon their membership a *cachet* of some substance—sometimes of such an order that the profession catered for becomes a closed corporation, as is the case in medicine and law. For some professions, the professional body creates such a position that whilst public appointments are restricted to their members, private employment is not so circumscribed. The major defect of the qualifying institutes or their equivalents is that their members, once having qualified, merely pay their annual subscriptions and fail to take a personal interest in the conduct of their professional association. We cannot imagine that under its present leadership anything of this nature could overtake the Institute of British Foundrymen. There is no need to repeat any criticisms against the new movement, as the conduct of the Institute in the past has been above reproach, but no association of this kind can remain static. It has not slavishly followed the precepts of the older institutes, but in many directions has created new ideals and methods which have been widely emulated. The desire for expansion was both natural and insistent, but expansion costs money. There has been much loose talk about status, but status cannot be bought by paying an increased subscription or by passing an examination. It is established through the recognition by the man in the street and *confrères* that an appellation is synonymous with dignity and integrity. This recognition is accorded when, and only when, the mass of the people entitled to use an appellation *assume* that they possess dignity and integrity and invariably demonstrate those attributes. The opinion people have of any particular title or word is not static; for example, the appellation "apothecary" at the beginning of the eighteenth century was exactly the same as that of a doctor to-day. Again, Watt, Boulton and the other great pioneers of engineering were proud to call themselves "mechanics," a word to-day almost exclusively reserved for the operative. The word "foundrymen"—which, by the way, appears in no dictionary—is one which in professional circles is achieving a worthwhile recognition. Its future standing will depend upon the lustre acquired by its leaders and the general conduct of the rank and file.

In the conduct of an Institute, or indeed any society, the main object is to create a maximum of interest in its well-being by according to the maximum some form of active participation. It has been in this direction where the Institute of British Foundrymen has been particularly successful, and the percentage of members who contribute personal service to the Institute appears to us to be distinctly higher than in any other of which we have personal knowledge. This phase of the work of the Institute must be cultivated still more intensively, and the new rules to be submitted to the Privy Council are so ordered that activity can be extended to carry out the ideals postulated by its founders in 1904. These ideals were not different from those actuating the present officers, but their activities were obviously limited by numerical strength and financial impotency. Now that the financial structure of the Institute will be comparable with the other learned engineering and metallurgical societies, and its membership totals well over the 2,000 mark, there is every reason to believe that it will go from strength to strength, and that the great industry which it has served so faithfully for 34 years will benefit in increased measure in the future. The foundry industry is both cognisant and appreciative of its past work, as is shown by the spontaneous endowments given by Mr. E. J. Fox, the National Ironfounding Employers' Federation, Qualcast and the Buchanan medal fund donor, and wonderful financial support accorded each year for the conference funds. Co-operation has been effected with all allied Institutes both at home and abroad. It is for giving increased service to its members and to the industry, whilst seeking further technical co-operation but still maintaining at all costs complete independence that the increased activities of the Institute are to be directed in the future. In this endeavour they have our best wishes and the assurance of our wholehearted support.

D

Still More Copper

By "ONLOOKER."

The copper producers do not believe in doing things by halves, and when they found that their announcement of a 10 per cent. increase in output failed entirely to check the swiftly moving upward trend of the market, their next step was a drastic one, no less than a decision to open the floodgates and permit unrestricted production and selling. The market was surprised, and that is putting it mildly, but nevertheless, the quotation that followed the announcement moved higher, although business in the early sessions was done at a price well above the close. The following day, however, saw a spate of liquidation and heavy selling by speculators which brought values down with a run, the severity of the fall being mainly due to the uncovering of stop-loss selling orders. At £45 15s. or thereabouts buyers overcame this downward thrust and a quick rally occurred, but the rise lacked conviction, and following a weak session on Wall Street copper values in London slipped back again. Conditions are now unsettled and it looks as if fluctuations will be the order of the day in Whittington Avenue for the immediate future, but unless the newborn optimism in America is all to evaporate a serious reaction in copper values would appear to be unlikely.

Reduction of Stocks Anticipated

We must wait nearly three weeks for the October statistics, and it is quite possible that they will not be so good as those for the previous month, but judging by the way things are going the writer imagines that these figures are going to be good and likely to show a further reduction in stocks of refined metal. There is undoubtedly a scarcity of early copper and all the de-restriction in the world will not serve as a sudden corrective, for as everyone knows it takes time to pass the metal through its various processes from the mine to the finished state. Estimation of what a return to a full rate of output would mean in the way of additional tonnage is not easy, but probably the increase would not be less than 300,000 tons per annum, a figure which would more than balance the present disparity between consumption and production. In the opinion of the writer, however, it is unthinkable that the mining companies comprising the copper cartel should decide to take such an extreme view of the needs of the situation; much more likely that for the present a further 10 per cent. will be added to that already decided upon on October 10, until it is possible to see how things are going to shape both in Europe and in the U.S.A. The producers are very wisely scared of a runaway market such as they saw last year, but on the other hand they do not wish to precipitate a slump.

Price Fluctuation Limits

It has been reported that the producers are aiming at a price of £45 per ton, but whether this means standard, electro or some sort of average between the two is not apparent. A further suggestion is that a fluctuation of £7 up and £7 down would not be considered amiss, and it is good to know that no attempt will be made to peg the quotation at one particular level. Control of output is, of course, never very easy, and in spite of all their experience the extra-American copper producers must find it hard to sum up the situation accurately. The speculator is always something of an unknown quantity, and it is not particularly easy to decide what his reaction to any particular course of action will be. Has the decision to put copper production on the broadest possible basis come soon enough to avert a squeeze in electro before the additional metal comes along? Time alone can tell, but the writer thinks it would be dangerous to sell short just now.

Trading Conditions in the Light Castings Industry

An explanation of the recent lull in the light-castings industry was given by MR. J. M. PRIMROSE, managing director of the Grangemouth Iron Company, Limited, when he addressed members of the Falkirk Section of the Institute of British Foundrymen at a social evening recently.

He declared that the slump was not due to the war scare, nor was it in any way connected with the rearmament schemes, but rather was it due to high prices. Rearmament had not affected the trade at all, but it had resulted in a raising of the costs for houses, and this was causing everyone in the building industry to keep their hands in their pockets.

One heard of huge numbers of housing schemes being sanctioned, and in view of that one might assume that all the foundries should be busy. The explanation was that, although the plans for the houses had been passed by the authorities, the work of building had not been started. What many people did not realise was that, after plans had been passed by the local authorities, one need not build right away—one could wait for three years. That was what everybody was doing just now.

On the other side, prices were too low. Both ironfounders and merchants realised a long time ago that this slump was coming and that they would have to reduce prices to sell certain articles. But they decided that if they could not sell their goods at a profit they would not sell them at all. They decided to "mark time," believing that things would straighten out eventually. To sell at uneconomic prices would mean ruination for everyone. It was thought that the industry would surmount the depression more quickly if it refrained from cutting prices. It was impossible to regulate prices, and to-day, in certain parts of England, certain articles were being made and sold at such prices that, even if Falkirk people decided to make them without giving any wages, they could not meet such competition!

Concluding, Mr. Primrose said it was apparent therefore that in some cases prices were far too high, while in others they were too low. He foresaw, however, that the costs of raw materials were coming down, and he thought that some people were beginning to realise that it did not pay to sell goods for next to nothing. Falkirk was going to come into its own within the next few months, for he believed the tide had turned and an upward trend was apparent.

Changes in the Iron Trade

No one could understand what had caused the slump in the iron trade, said Mr. T. McKenna, general secretary of the National Union of Blast-furnacemen, when he spoke at a gathering at Millom recently. Since 1919 all the years had proved to be lean ones for the blast-furnacemen, with few exceptions. It was not so much a matter of wages as of employment; 1934 was a good year, 1935 better and 1936 and 1937 remarkable years. Then came the slump of 1938, and out of 136 furnaces operating 10 months ago 59 were now out of blast. No one knew the reason, and he quoted a case in which an employer made a speech predicting that 1938 was going to be a tip-top year. At the same time the slump had set in. Out of 100 men employed 12 months ago, 45 were unemployed to-day. It was a serious matter, and one they had got to take up with the Government of the day. Mr. A. Callighan, of Workington, West Coast secretary, recalled the great changes that had taken place in the iron-making industry of North Lancashire and Cumberland. The number of active furnaces had declined from 20 to five. Just after the war merchant plants—furnaces making iron for sale on the open market and not for use in adjoining steelworks—were operating at Carnforth, Ulverston, Millom, Distington, Cleator Moor, Solway (Maryport), and Old Side (Workington). They had all gone except Millom.

Random Shots

With the exception of Francis Everton's crime stories, it is not often that one finds that the setting of a novel is the foundry or the steelworks. Recently, however, there has been published a book called "Portrait in Steel," written by Leonora Thornber, which deals with the conflicts between ambitions and ideals of a man engaged in the armament trade. "Marksman" hesitates to recommend this until he has read it, lest the author, a woman mark you, has rushed in where angels (more expert perhaps) would fear to tread. Even the reviewer says of the hero that he is "a maker of the metal that can produce ploughshares or guns" an alloy better known on the Stock Exchange than in industry. The specially delicious piece of literature with which "Marksman" is concerned this week is in the nature of an essay found by accident in one of the school exercise books which little Tommy automatically brings home when they are full. Here it is in its entirety, reproduced at great risk of being called "a rotten cad" should the youthful author ever find out.

* * *

"The Watford Foundry."

(One imagines the subject set was to describe a recent visit of interest, as little Mary is known to have accompanied her father there one Saturday morning.)

"One day," it reads, "a queer little man was walking along the Watford By-pass, now thingking the foundry was his home, he walked in. (This little man was a knome.) So seeing it was a foundry he made himself invisible. (This was in 1936.) The first thing he saw was some men pouring licquid metal in-to a mould. Then he went in-to the next room where there was a tumbling barrle which went round and round, and out came dust which made our little man's beard grey, now he thought this is to much for me, so he went of to his real home and never went in anywhere els's house or place."

The end.

Does Mr. Crump remember seeing a gnome about the place in 1936?

* * *

Whilst one's thoughts are on school, a teacher asked his class who invented the arc-lamp. There were many suggestions, some stupid and all wrong, but the brightest answer came from the boy who said that it must have been Noah, because he would need them for flood-lighting.

* * *

A fellow traveller on the 9.10 train up to town invariably shares his crossword puzzle with "Marksman," saving those clues which he says are far too technical for him. "What tool is made by the French and English?" he asked the other day. Whilst suffering the agonies of making a mental survey of all the recent catalogues received from both French and English foundry suppliers, the inveterate solver of crossword puzzles quietly wrote in the answer. It was simply "Lathe." Easy, isn't it?

* * *

Another day he shot out the question, "What sort of stain is not used in the foundry contrary to expectation?" Once again the poor expert's brain reeled over patternshop varnishes and such like mysteries of the internal workings of foundries. Once again the solver of puzzles quietly wrote in the answer. This time it was just "Ironmould."

* * *

But this is one he didn't ask his companion to solve. The dirty dog was all for keeping the joke to himself. "The sort of bird for your car?" Perhaps, on second thoughts, he couldn't ask a question like that. It might sound altogether too personal. However, the answer was delightfully non-committal, after all, for it was nothing more or less than "a dicky."

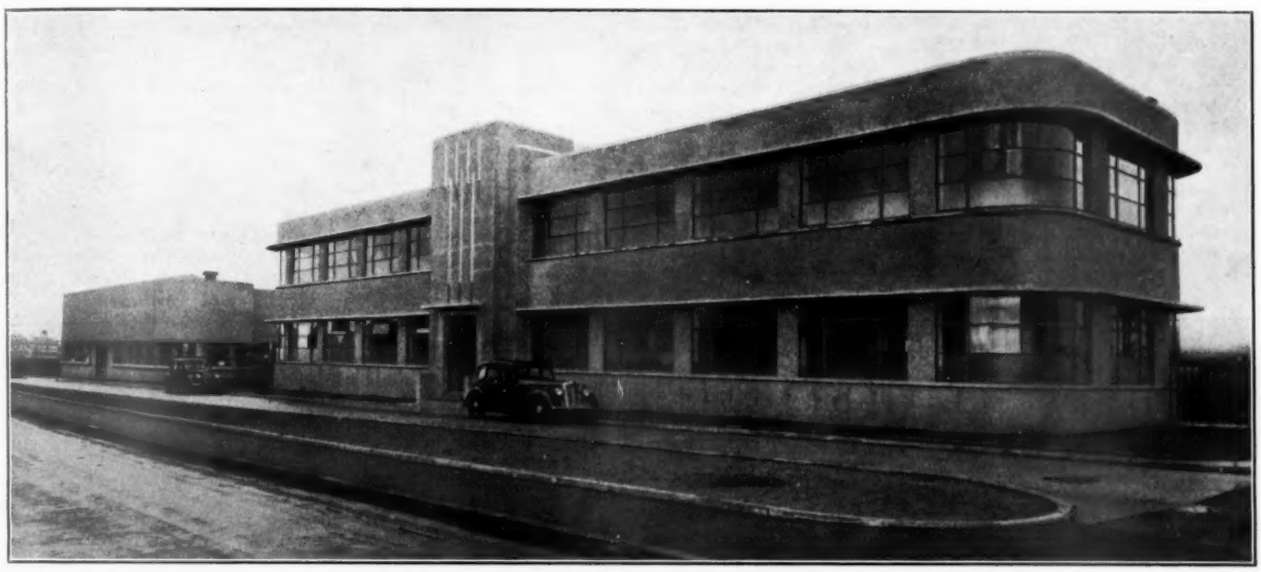
"MARKSMAN."

New Research Laboratories of the Clyde Alloy Steel Company, Limited

A SELF-CONTAINED UNIT

The Clyde Alloy Steel Company, Limited, has recently put into commission new research laboratories at Craigneuk Works, Motherwell. This new venture will enable the company to maintain its premier place in the manufacture and supply of special steels in bars, forgings and castings for most purposes, in which business it has been engaged since its inception in 1919. Scientific control and management have characterised this company's activities right from the beginning, and the provision of the most up-to-date facilities at this time emphasises a continuity of that policy.

The building throughout is constructed in reinforced concrete with Tuscan floors, the inside walls being lined with Pioneer blocks. This system gives insulation and freedom from echo inside the building and obviates the sweating of the plastered walls. The interior finish is Kean's cement, the ceilings and upper parts of the walls being coated with titanium paint in a cream shade, with a grey dado and horizontal line. The main floor is rubber in colours to harmonise with the general scheme. The remaining floors are covered with teak blocks, and all the gas, water, and electricity supplies are led through troughs in the floor covered by continuous traps. The electric light fittings are totally enclosed with reflectors and diffusing bowls that give a very even distribution of light. Special consideration has been given to heating and ventilation, and conditioned air is supplied throughout from a plant installed in the basement, while the flues from the fume cupboards are connected to an extractor fan.



General View of the New Research Laboratories.

Chemical Laboratory

The chemical laboratory occupies the top floor of one wing of the building. The work benches are spaced along the centre of the floor, with ample space all round. Each bench has its own sink and cooling tanks, and the bench tops are covered with grey acid-proof rubber. The sink surrounds are covered in white acid-proof rubber to provide an easily cleaned surface to match the sinks. Along one side of the laboratory are placed the fume cupboards in close proximity to the work benches.

The other side of the laboratory is partitioned off to form the store, carbon combustion room, balance room, and chief chemist's room. These rooms have been designed and located for the maximum convenience, the store being close to a lift which connects the laboratory with the machine shop below where all samples are prepared and supplies are unpacked.

Each chemist has his own bench, fume cupboard, hot plate, cooling tank and balance. Apparatus suitable for the work being done is kept in the cupboards below the benches and replacements are obtained from the store at fixed times.

Test House

The floor below the chemical laboratory is occupied by the test house, with an adjoining machine shop. The test house is equipped with machines for all kinds of tests. The principle of each department having its own offices is here adhered to and one side of the test house is partitioned to form an inspector's room, the test-house superintendent's room, and a filing and store room.

View in the Chemical Laboratory.

View in the Test House.

Physical Laboratory

Both floors of the southern wing of the building are occupied by the physical laboratory. On the ground floor adjoining the entrance hall the chief metallurgist's room is situated at the front of the building, and in a corresponding position

at the back is a conference room and library. The heat-treatment laboratory with the store room and assistant metallurgist's room occupies the remainder of the floor. In this laboratory are carried out all the experimental heat-treatments. Carbonising treatments are carried out here for the grain-size control of many of the steels produced in the works and experimental work is conducted to examine the effect of heat-treatment on new qualities of steel or to meet the particular requirements of customers.

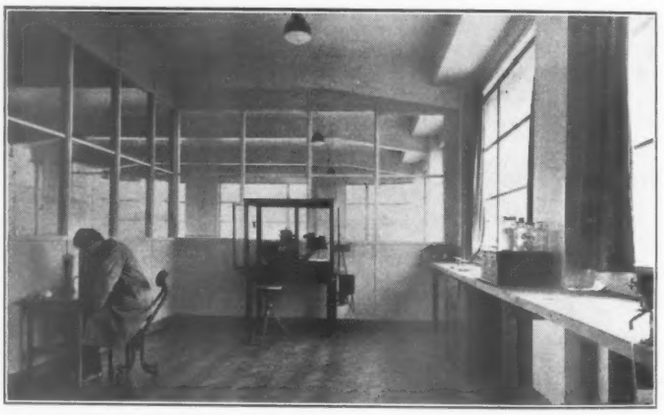
The equipment consists of electric muffle and tube furnaces, most of which are fitted with thermostatic control. Oil- and water-quenching tanks of large capacity are mounted on rubber castors so that they may be placed in close proximity to any furnace as required. As a check on the heat-treatments carried out in the laboratory and in the works, hardness tests are made on a diamond-hardness machine situated in this department, in addition to the routine Brinell-hardness tests normally carried out.

In this laboratory are conducted also the routine micro-tests to control the quality of the company's products. These comprise deep etching and sulphur printing to detect segregation, porosity, and other defects. In addition to these, special tests are carried out for particular purposes. For convenience in dealing with the acids and heavy sections used in deep etching a corner of the laboratory is fitted with a fume cupboard, a large-size sink built at a low level and a bench covered with acid-resisting rubber being adjacent.

The upper floor of the physical laboratory is divided into a large general laboratory, a polishing and photography room, and a photographic dark room. The general laboratory is used for work of a specialised nature and space is available to provide additional accommodation as required. Corrosion tests on special qualities of acid-resisting steels are carried out and foundry-moulding materials are also tested here. The preparation of micro-sections up to the polishing stage is done in the general laboratory to avoid contamination with grit of the polishing apparatus in the polishing room.

The photographic equipment includes a stand camera for photographing castings and other large objects, and for photo-micrography there is a Vickers projection microscope with lenses giving a range of magnification up to 2,500 diameters. The final polishing of micro-sections is carried out on a rotating wheel and for fine work hand-finishing is employed. The projection microscope is used for inclusion counts on the steels produced in the works, the system used having been developed in the laboratories, and for the determination of the grain size in controlled steel. For the routine examination of microstructures there is a Reichart bench microscope with its own optical equipment.

VIEW IN THE HEAT-TREATMENT LABORATORY.



VIEW IN THE PHYSICAL LABORATORY.

Institute of British Foundrymen

ELECTION OF NEW MEMBERS

At a meeting of the Council of the Institute of British Foundrymen in Manchester on October 15, the following were elected to the various grades of membership

As Subscribing Firm.

Fullwood Foundry Company, Limited, ironfounders, Fullwood Works, Mossend (representative: R. Ballantine).

As Members.

W. R. Bailey, managing director, C. H. Bailey, Limited, Cardiff; J. S. Barry, pig-iron salesman, W. Jacks & Company, London; E. W. Dowson, steelworks chemist, Wolsingham Steel Company, Limited, Wolsingham; N. O. Garside, director, Garside & Derrington, Halifax; D. R. Greenhalgh, foundry manager, J. Shaw & Son, Huddersfield; G. W. Harris, director, Broad & Company, Limited, ironfounders, London; W. D. Jones, M.Eng., Ph.D., consulting metallurgist, London; W. M. Larke, B.A., works manager, Stanton Ironworks Company, Limited; G. T. O. Martin, B.Sc., Ph.D., research assistant, B.C.I.R.A., Birmingham; J. Masters, Junr., representative, Fordath Engineering Company, Limited, West Bromwich; T. Morrison, foundry foreman, East Rand Engineering Company, Germiston, S.A.; M. A. Moussa, mechanical engineer, Butterworth & Dickinson, Limited, Burnley; R. E. Nettleton, foreman iron moulder, Wright, Boag & Company, Limited, Johannesburg, S.A.; A. J. Simpson, pig-iron salesman, Stanton Ironworks Company, Limited; S. J. Thewlis, foundry manager, Lane Foundry, Brimsdown; F. H. Vinnell, manager, A. Sheldon & Sons, Limited, Wells; C. A. Watt, representative, Armstrong Whitworth Pneumatic Tools, Limited; T. H. Weaver, foundry production manager, W. T. Avery, Limited, Birmingham; A. E. Wilson, industrial gas technologist, Huddersfield Corporation.

As Associate Members.

A. Beardsley, Stanton Ironworks Company, Limited; J. Bolton, assistant secretary, Institute of British Foundrymen, Manchester, 3; W. H. Cantrill, foreman patternmaker, Plowright Bros., Limited, Chesterfield; W. Collier, foreman patternmaker, R. S. Wittig & Company (Compressors), Limited, Radcliffe, Manchester; W. J. Driscoll, assistant metallurgist, B.C.I.R.A., Birmingham; F. Dumelow, assistant foreman, S. Russell & Sons, Limited, Leicester; D. Fleming, chemist and metallurgist, Gresham & Craven, Limited, Salford; D. G. Garner, B.Sc., metallurgist, B.C.I.R.A., Birmingham; N. S. Hosking, assistant to foundry manager, English Steel Corporation, Limited, Sheffield; W. Hughes, coreshop foreman, Qualcast, Limited, Derby; V. L. Nicholls, metallurgical chemist, Bakers' Foundry Company, Limited, Smethwick; H. Pinchin, Stanton Ironworks Company, Limited; D. A. Richards, foundry executive, T. Richards & Sons, Limited, Bristol; E. B. Richards, foundry executive, T. Richards & Sons, Limited, Bristol; D. G. Waldeck, foreman patternmaker, Wright, Boag & Company, Limited, Johannesburg, S.A.; F. W. Taylor, under-foundry manager, Chamberlin & Hill, Limited, Walsall.

As Associate.

G. R. Feakes, moulder, Vulcan Engineering Works, Benoni, S.A.

Publication Received

Report on Economic and Commercial Conditions in Poland. By A. F. Merry, M.C. (recently acting Commercial Counsellor to H.M. Embassy, Warsaw). Published by H.M. Stationery Office, York House, Kingsway, London, W.C.2. Price 1s. 1d. post free.

Industrial expansion in Poland, which began in 1936, continued in 1937 on an extensive scale. The bulk of this expansion is taking place in the "strategic triangle," situated towards the South of Poland, to which the Government is endeavouring, whenever possible, to transfer key industries. The improvement of industrial conditions has not failed to benefit the agricultural community, and Poland is at present experiencing a phase of relative prosperity. As a consequence of these developments there has been a considerable increase in imports of machinery and raw materials, with the result that, although exports increased to a certain extent, the balance of trade has become definitely adverse to Poland.

In her trade with the United Kingdom, Poland continues to enjoy a considerable favourable balance. Imports from the United Kingdom have risen, but their percentage has fallen from 14.1 of total Polish imports in 1936 to 11.9 in 1937. Trade has to a certain extent been diverted to countries with which Clearing or Compensation Agreements are in force, but it is emphasised that in spite of quota restrictions considerable possibility for the marketing of United Kingdom goods in Poland still exists, particularly as few countries are able to compete with the United Kingdom in the granting of credit facilities.

In addition to industrial developments and trade, agriculture, transport and social conditions are also reviewed. A section containing some hints likely to be of assistance to commercial visitors to Poland is included in the report, together with statistical appendices.

Influence of Titanium and Molybdenum on the Magnetic Properties of Fe-Ni-Al Alloys*

By Prof. FESZCZENCKO-CZOPIWSKI and Dr. L. KOZLOWSKI

Permanent magnets are characterised by a high coercive force and as strong a remanence as possible. The latter should in consequence be associated with pronounced internal tensions, so established, however, that they do not induce cracking. Primarily, the complex system of carbides disseminated in a solid solution supplies these tensions in alloys for magnets. Recently, magnets of minimum carbon content, in which the hardening is effected by means of a dispersive precipitation of a supplementary phase, have become universally standard. Amongst alloys of this type, the ternary Fe-Ni-Al alloys having the approximate composition of Fe_2NiAl, discovered in 1931 by Prof. Mishimer, play a predominant part.

Köster has carried out a series of microscopic and magnetic researches[1] on the ternary Fe-Ni-Al system, and has shown that within the region of the alloys used for magnets there exists at high temperatures a monophasic solid solution of the centred system (phase α). At room temperatures the equilibrium structure is a mixture of two phases α and γ, γ being a non-magnetic solution of the face-centred system. By heating to above 1,200 deg. C., followed by a sufficiently rapid cooling, there results at room temperature the α solid solution. The subsequent tempering will cause the precipitation of the γ phase in a state of extremely fine dispersion and thereby confer upon the alloy its magnetic permanency.

Recent X-ray researches on the ternary Fe-Ni-Al system carried out by Bradley and Taylor[2] do not entirely confirm Köster's findings. These workers have concluded that the γ phase of the face-centred system is not shown in the alloys of compositions corresponding to Fe_2NiAl, slowly cooled from high temperatures. The decomposition which takes place is ascribed to a separation of the phase of the centred system of high iron content from the rest of the matter; thus, for example Fe_2NiAl can decompose into $Fe_{36}NiAl$ and $Fe_6Ni_7Al_7$. These researches, as well as those of Burgers and of Snoek,[3] set out the mechanism of the process necessary for the high coercive force of the alloy. At high temperatures only the phase of the centred system exists, and the Ni atoms are completely separated from those of Al, whilst the Fe atoms are distributed indiscriminately—some replacing Ni atoms and some those of Al. An appropriate thermal treatment modifies this state of repartition, by setting up the partial separation of the Fe atoms from the rest of the atoms. As a result, small aggregates, or "islets," are formed. They are rich in iron atoms, the appearance of which is not always accompanied by their precipitation in the form of a supplementary phase. The parameter of the system of the "islets" is identical to that of the initial system. Under these circumstances, the iron atoms are often found under the action of strong tensions, which are productive of the high coercive force of the Fe_2NiAl alloys.

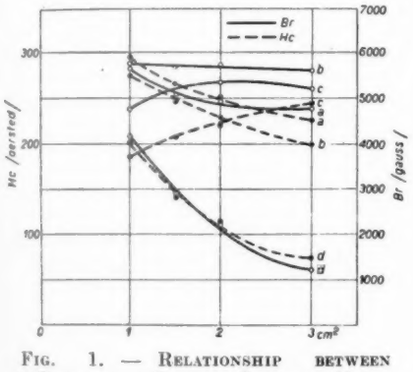


Fig. 1. — Relationship between Remanence B_r and Coercive Force H_c of As-Cast Test-Bars, and Section Surface of Test-Bar in sq. cm.

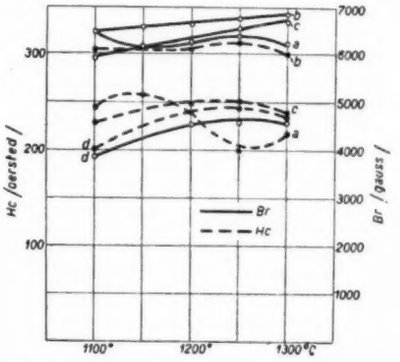


Fig. 2. — Relationship between Remanence B_r and Coercive Force H_c of Oil-Quenched Test-Bars (3 sq. cm.), and the Temperature of Quenching.

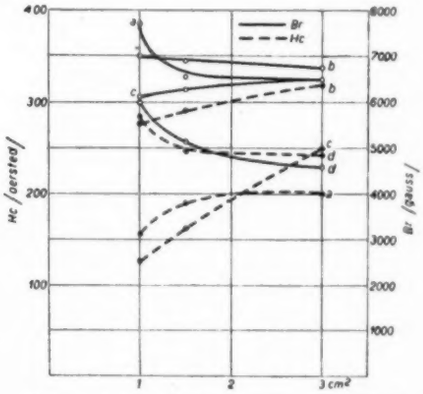


Fig. 3. — Relationship between Remanence B_r and Coercive Force H_c of Test-Bars Oil-Quenched at 1,250 deg. C., and Section Surface of Test-Bar in sq. cm.

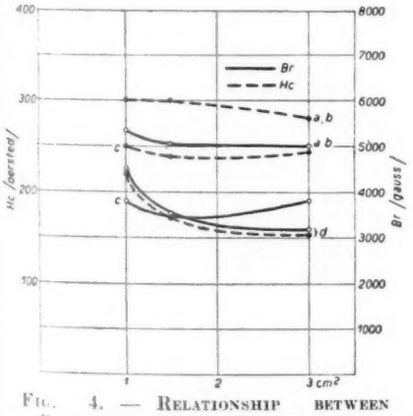


Fig. 4. — Relationship between Remanence B_r and Coercive Force H_c of Test-Bars Air-Quenched at 1,250 deg. C., and Section Surface of Test-Bar in sq. cm.

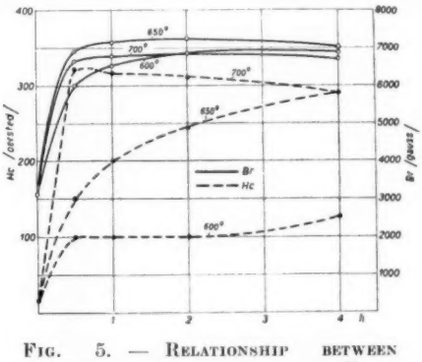


Fig. 5. — Relationship between Remanence B_r and Coercive Force H_c of Cast c Test-Bars Water-Quenched and Tempered at 600, 650 and 700 deg. C., and the Duration of Tempering in Hours.

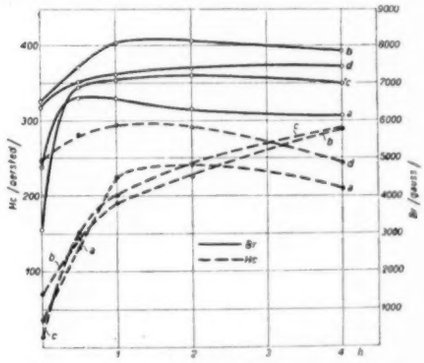


Fig. 6. — Relationship between Remanence B_r and Coercive Force H_c of Test-Bars (3 sq. cm.) Water-Quenched at 1,250 deg. C., and Tempered at 650 deg., and the Duration of Tempering in Hours.

Experimental Work

Meskin and Somin,[4] Pölzguter,[5] Liwschitz[6] and other workers have carried out a vast amount of research on the composition, casting methods and heat-treatment of permanent magnets. Additionally, the Baildon Works Research Institute has for a long time carried out an experimental study of these alloys.[7] The present work had for its object the acquiring of further knowledge of the influence of additions of titanium and molybdenum on the magnetic properties of Fe-Ni-Al alloys. The various samples were cast from charges melted in a 2-cwt. high-frequency furnace installed in the Baildon steel works. Table I details the composition of the four casts made.

More than 210 sand-cast samples were yielded by each cast, of the following dimensions:—18 by 18 by 103 mm.; 18 by 9 by 103 mm.; 18 by 6 by 103 mm.; 25 by 12 by 103 mm.; 25 by 6 by 103 mm., and 18 by 12 by 103 mm. When the

* Paper presented to the Polish International Foundry Congress. The authors are associated with the Baildon Katowice Research Institute.

temperature of the charge reached about 1,250 deg. C., then only were the additions of Al and Ti made, that is, immediately prior to the pouring of the cast into the ladle. The temperature of casting of the actual samples was of the order of 1,450 deg. C.* An apparatus of the Hartmann-Braun type was used for ascertaining the magnetic properties. The samples were magnetised by an electromagnet in a field of about 2,000 to 2,500 oersteds. The intensity of the field of the electromagnet was determined by means of a bismuth spiral, by measuring the variation of its resistance in the magnetic field by means of a Wheatstone bridge. The intensity of this field was too feeble for the type of alloys studied. It is possible that this fact may be the cause of the inferiority of the authors' results when compared with those obtained by others working upon the same alloys submitted to a similar heat-treatment.

Fig. 1 shows the results of the measurements of the magnetic properties of the samples cast. Exception is to be taken to cast *c*, where the coercive force and the remanence increase with the decrease of the section surface of the samples. The speed of cooling in the mould was too slow for the samples, and these were subjected to heat-treatment of an ameliorative character, by quenching the samples from high temperature and tempering them at lower ones. The samples were heated up to 1,100, 1,150, 1,200, 1,250 and 1,300 deg. for a period of 15 to 20 min., and quenched either in water, oil or even air. Figs. 2, 3 and 4 give the results obtained. The quenched samples were then submitted to tempering at 600, 650 and 700 deg. C. Initially, tempering at 550 deg. C. was also included, but as the variations in results were shown up very slowly, this series was abandoned in the later work. Fig. 5 shows the effect of the temperature and the tempering period on the magnetic properties of samples from cast *c*, quenched in water. For samples from the other three casts, quenched in water or oil, the nature of the curves is virtually the same. Figs. 6 and 7 indicate the influence of the tempering time on the magnetic properties of samples quenched from 1,250 deg. in water or oil and then tempered at 650 deg. C.

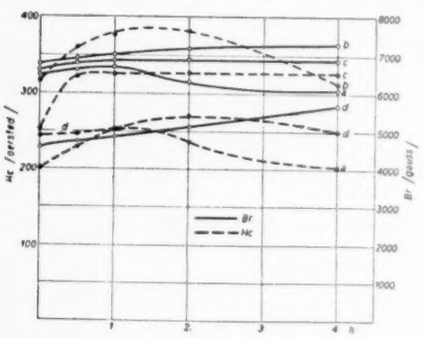


FIG. 7. — RELATIONSHIP BETWEEN REMANENCE B_r AND COERCIVE FORCE H_c OF TEST-BARS (3 SQ. CM.) OIL-QUENCHED AT 1,250 DEG. C. AND TEMPERED AT 650 DEG. C., AND THE DURATION OF TEMPERING IN HOURS.

* We are unable to reconcile these two statements of temperature as related to process.—EDITOR

The tempering of samples cooled in air has equally had an ameliorative effect on the magnetic properties. The increase in values of H_c and B_r was relatively small for casts *a* and *d*. Tempering for 2 hrs. at 600 deg. C. of the samples from cast *b* induced an increase in H_c of 30 to 40 oersteds and in B_r of about 600 gauss. In the case of cast *c*, a tempering for 2 hrs. at 650 deg. C. caused the value of H_c to rise from 250 to 310 oersteds and that of B_r from 3,700 to 6,000 gauss.

Conclusion

(1) The coercive force and the remenance of the samples from casts *a*, *b* and *d* increase with the decrease in their section surface. In the case of cast *c* the position is reversed.

TABLE I.—*Composition of Charges.*

Cast No.	C	Si	Mn	S	P	Ni	Al	Ti	Cu
a	0.05	0.45	0.15	0.008	0.008	27.16	12.03	—	0.045
b	0.05	0.38	0.22	0.009	0.009	28.36	10.35	0.98	0.149
c	0.05	0.22	0.25	0.011	0.013	27.92	9.79	2.16	0.218
								Mo	
d	0.05	0.24	0.16	0.007	0.011	28.31	10.87	2.05	0.126

(2) The most effective heat-treatment for producing the maximum values for the coercive force and the remenance of the samples from casts *a*, *b* and *c* consists of oil quenching from 1,200 to 1,250 deg. C., followed by tempering for 2 hrs. at 650 deg. C.

(3) The addition of 1 to 2 per cent. of titanium serves to increase the coercive force and remenance of the Fe-Al-Ni alloy, provided the magnets cast are submitted to the above-mentioned thermal treatment.

(4) The addition of molybdenum has a deleterious effect upon the magnetic properties in the "as-cast" condition. The speed of precipitation of the supplementary phase is, compared with the three casts previously cited, considerably better. From this fact, the heat-treatment indicated by the authors for that particular category of alloys consists in water quenching from 1,200 to 1,250 deg., and then tempering for between one and two hours at 650 deg. C.

TABLE II.—*Optimum Magnetic Properties given by the Various Casts.*

Cast No.	Heat-treatment.	B_r Gauss.	H_c Oersted.	$B_r \times H_c$ 10^{-4}.
a	Oil quenched from 1,250 deg. C. and tempered from 1 hour at 650 deg. C.	6,700	260	174
b	As for cast *a*, but tempering time 2 hours	7,200	380	272
c	As for cast *a* ..	6,900	325	225
d	Water quenched from 1,250 deg. C. and tempered for 1–2 hours at 650 deg. C.	7,400	290	215

Table II sets out the maximum results of the measurements of the magnetic properties of the samples submitted successively to quenching and tempering.

REFERENCES.

[1] W. Köster. Arch. f. d. Eisenhüttenwesen, vol. 7, 1933–4, pp. 257–62.
[2] "Magnetism." Physics in Industry." Institute of Physics (London), p. 95.
[3] W. Burgers and I. Snoek. "Physica," vol. 12, 1935, p. 1064.
[4] W. S. Meskin and B. E. Somin. Katch. Stal, no. 2, p. 28, 1935.
[5] F. Pölzguter. "Stahl u. Eisen," 1935, p. 835.
[6] B. G. Liwschitz. Katch. Stal, no. 10, p. 12; no. 12, p. 39, 1937.
[7] I. Feszczenko-Czopiwski, T. Malkiewicz and Cz. Stoch. Hutnik X, no. 2, 1938, p. 101.

ON THE PETITION of a shareholder, Mr. Justice Bennett, in the Chancery Division, on October 17, made an order for the compulsory winding up of Salerni Coupling, Limited. The company was not represented and did not appear.

Company Meeting

United Steel Companies

RECORD PRODUCTION AND PROFIT

The annual general meeting of the United Steel Companies, Limited, was held at 21, Tothill Street, London, S.W., on Friday, October 14, SIR W. BENTON JONES, BT. (the chairman), presiding.

The chairman said that the year ended June 30, 1938, was the fifth year in succession in which the directors had been able to report a year of trading and financial results which were better than the year before. The company reached its highest rate of production and earned its largest profit.

After dealing with the accounts, he said that a year ago the directors had reported that the works of the company and its subsidiaries had been operated continuously at a high rate and production had been greater than in the previous year. The high rate continued until the first quarter of 1938, when the speed began to fall, and in the second quarter the fall continued.

Steel production in Great Britain in 1937 was 135 per cent. of the production of 1929. In Western Europe, excluding Great Britain, production in 1937 was 98 per cent. of 1929. In the United States of America the production in 1937 was 89 per cent. of 1929. In the first six months of 1938 production declined in Great Britain to a rate which was 123 per cent. of 1929, in Western Europe to 93 per cent. of 1929, and in the United States to 38 per cent. of 1929. An indication of the future might be found in the records of recent production month by month. It was to be hoped that these figures indicated a turn of the tide. In Great Britain exceptional circumstances had accentuated the recession, but the effect of these exceptional circumstances, he thought, must by now be nearly passed, and unless actual consumption declined further a larger proportion of home-made steel and iron would be required.

Importance of Pig-Iron

He referred to the recent difficulty in obtaining sufficient materials at home to supply the steelworks when working at maximum production. He said: "If the steel trade is to be self-supporting it must make sufficient pig-iron to meet its maximum needs. Pig-iron is a very suitable commodity to store. It is too heavy to be pilfered; it occupies very little space; it is very easily handled, and it does not deteriorate appreciably. It seems obvious to suggest that the steel trade should organise the storing of pig-iron in lean times and draw on its store when demand is high. Such an arrangement would make it unnecessary to provide more pig-iron making capacity than is required by the average demand. It would enable selected pig-iron works to operate at a uniform rate, and at the same time would provide cokemakers and colliery proprietors with a uniform outlet for the coal and coke consumed directly and indirectly in the manufacture of pig-iron."

Referring to prices, he had heard it said that they were too high, and that a reduction in price was required to stimulate buying. If this means that a reduction should be made in price with the object of stimulating demand without proper regard to cost, it was unreasonable. The prices of steel had been regulated during the recent trade activity. In spite of rising costs little change had been made until in May, 1937. Later the prices then fixed were stabilised until the end of this year to allow buyers to undertake forward commitments without risk. He did not think it would be denied that if prices had been free they would have risen to a higher level than they were to-day. Prices had been regulated by reference to costs when trade activity was rising, and the only good reason for reducing prices would be a fall in costs.

The directors had again given an addendum to their report. This time its object was to make the stockholders acquainted with the Appleby-Frodingham properties, to convey in short non-technical language a description of the Lincolnshire districts and other Appleby-Frodingham works and to give some idea of the importance both of the Lincolnshire district and of the extensions which were being made there. This addendum indicated the growth of the steel industry in Lincolnshire; the facilities which the district possessed and the advantages which might be expected to be derived from the extensions.

The new works when completed would measure from end to end one and a-half miles, and at the widest point a quarter of a mile. At Samuel Fox & Company's works the policy of development in the lighter section of the trade was being continued.

Third Report of the Steel Castings Research Committee*

By a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation

INTRODUCTION

Since the Committee's Second Report was issued in 1936 the membership of the Committee has been increased, and the constitution is now as under:

Mr. W. J. Dawson (Chairman), Hadfields, Limited.
Prof. J. H. Andrew, The University of Sheffield.
Mr. Malcolm Brown, Hadfields, Limited.
Mr. H. H. Burton, English Steel Corporation, Limited.
Mr. F. Cousans, Thos. Firth & John Brown, Limited (Scunthorpe).
Dr. C. J. Dadswell, English Steel Corporation, Limited.
Mr. E. C. Evans, The British Iron and Steel Federation (representing the Iron and Steel Industrial Research Council).
Dr. R. H. Greaves, The Research Department, Woolwich.
Mr. D. W. Hammond, Wm. Jessop & Sons, Limited.
Dr. W. H. Hatfield, F.R.S., The Brown-Firth Research Laboratories.
Mr. F. N. Lloyd, F. H. Lloyd & Company, Limited.
Mr. J. E. Mercer, Head, Wrightson & Company, Limited (representing the General Steel Castings Association).
Dr. H. Moore, C.B.E., The British Non-Ferrous Metals Research Association.
Mr. W. J. Rees, The University of Sheffield (representing the British Cast Iron Research Association).
Mr. W. F. Rowden, The Mond Nickel Company, Limited.
Mr. T. M. Service, Wm. Beardmore & Company, Limited.
Mr. T. R. Walker, English Steel Corporation, Limited (representing the Institute of British Foundrymen).
Mr. K. Headlam-Morley (Secretary), The Iron and Steel Institute.

The constitution of the Moulding Materials Sub-Committee remains unaltered.

Foundry Practice Sub-Committee

The Committee has deemed it desirable to establish a further Sub-Committee known as the Foundry Practice Sub-Committee. This body will devote its attention to the scientific study of matters relating to the actual production of castings.

The personnel is as follows:

Mr. F. N. Lloyd (Chairman), F. H. Lloyd & Company, Limited.
Mr. Malcolm Brown, Hadfields, Limited.
Mr. F. Cousans, Thos. Firth & John Brown, Limited (Scunthorpe).
Dr. C. J. Dadswell, English Steel Corporation, Limited.
Mr. J. E. Mercer, Head, Wrightson & Company, Limited.
Mr. T. R. Walker, English Steel Corporation, Limited.

This Sub-Committee is well qualified to deal with the subject, being composed principally of members actually engaged in the control of foundry operations. The Sub-Committee will pay special attention to the elucidation of fundamental principles, this method of attack being considered the most effective way of building up a sound manufacturing technique.

* Extracts from the full report presented at the annual meeting of the Iron and Steel Institute in London yesterday.

In connection with the Empire Exhibition, Glasgow, 1938, the Committee was invited by the Department of Scientific and Industrial Research to prepare an exhibit illustrating their work. The exhibit, displayed in the Iron and Steel Hall of the British Government Pavilion, comprised a number of alloy- and carbon-steel castings, demonstrating by means of machined cross-sections through the castings the high degree of soundness attainable in British steel castings of difficult form. The exhibit also included a number of specimens illustrating the researches being carried out by the Committee.

Table I.—*Soft Carbon Steel Heats.**

Cast no.	Tapping temp. Deg. C.	Temp. at end of casting. Deg. C.	Average length of "Ruff" rod. In.	Foundry remarks.
1	—	—	15.25	Hot and fluid.
2	—	—	13.75	Normal heat and fluidity.
3	—	—	13.00	Normal heat and fluidity.
4	—	—	15.50	Hot. Very fluid.
5	1,677	1,572	10.69	Normal heat and fluidity.
6	1,683	1,577	12.50	Hot and fluid.
7	1,652	1,547	12.71	Normal heat and fluidity.
8	1,677	1,577	10.87	Normal heat and fluidity.
9	1,583	—	12.83	Normal heat and fluidity.
10	1,652	1,560	11.75	Normal heat and fluidity.
11	1,629	1,536	11.50	Normal heat and fluidity.
12	1,652	1,572	8.94	Normal heat and fluidity.
13	1,664	1,572	14.25	Hot and fluid.
14	1,677	1,583	18.25	Hot. Very fluid.
15	1,652	1,577	10.00	Normal heat and fluidity.
16	1,677	1,572	12.37	Normal heat and fluidity.
17	1,677	1,577	16.25	Normal heat and fluidity.
18	1,700	1,583	12.00	Hot. Normal fluidity.
19	1,664	1,577	12.67	Normal heat and fluidity.
20	1,700	1,600	14.15	Hot and fluid.
21	1,629	1,554	9.75	Cool. Not fluid.
22	1,677	1,560	13.87	Hot. Normal fluidity.
23	1,640	1,560	13.12	Normal heat and fluidity.
24	1,664	1,583	13.12	Hot and fluid.
25	1,706	1,588	13.00	Hot and fluid.
26	1,652	1,560	9.50	Normal heat. Not fluid.
27	1,700	1,536	12.25	Hot and fluid.
28	1,677	1,565	14.12	Normal heat and fluidity.
29	1,652	1,565	14.75	Normal heat. Very fluid.
30	1,670	1,562	15.00	Hot and fluid.
31	1,683	1,583	13.25	Hot and fluid.

* The composition of these casts ranged from C 0.195 to 0.265; Si 0.32 to 0.51; Mn 0.7 to 1.06; S 0.018 to 0.035; and P 0.04 per cent.

The present Report is divided into six sections as follows:

Section I.—Introduction.

Section II.—The Fluidity of Iron-Carbon and other Iron Alloys:

Part A.—The Fluidity of Alloy Steels, by Prof. J. H. Andrew, Mr. G. T. C. Bottomley, Dr. W. R. Maddocks and Mr. R. T. Percival (Sheffield University).

Part B.—The Ruff Fluidity Test.

1.—Introductory Comments on the Ruff Test.

2.—Works Results Using the Ruff Fluidity Test, by Mr. T. R. Walker (Sheffield).

3.—Fluidity-Temperature Relations of Cast Steels of Various Compositions, by Dr. R. J. Sarjant and Mr. T. H. Middleham (Sheffield).

Section III.—Copper-Steel Castings, by Mr. Martin Alexander (Research Department, Woolwich).

Section IV.—Strength and Ductility of Cast Steel during Cooling from the Liquid State in Sand Moulds.—Part II, by Mr. H. F. Hall (Research Department, Woolwich).

Section V.—First Report of the Moulding Materials Sub-Committee.

Section VI.—Bibliography on the Manufacture, Properties and Testing of Steel Castings (not including Moulding Sands).

The work reported in Section II, Part A, is a continuation of the research carried out under the supervision of Prof. Andrew, and the present contribution completes this research. The results recorded are of considerable theoretical interest.

The Committee have given much consideration to the provision of a fluidity test capable of application under ordinary foundry conditions and which will serve as a reliable guide to the casting properties of steels in common use in the foundry. As a result of a large number of tests carried out by several foundries on various forms of test-pieces, the Committee have arrived at the conclusion that the most promising method is that devised by Dr.-Ing. Wolfram Ruff. This method, reported to the Iron and Steel Institute in June, 1936, has been described in the "Iron and Steel Institute, Carnegie Scholarship Memoirs," Vol. 25, and a brief account of the principles on which this test is founded is given at the commencement of Section II, Part B. That the method is capable of affording practical guidance to the foundryman is clearly shown by the results obtained in the series of tests recorded by Mr. T. R. Walker.

Special attention is directed to the research by Dr. R. J. Sarjant and Mr. T. H. Middleham, of the Research Laboratory of Hadfields, Limited, on the temperature-fluidity relation of cast steels of varying composition. The results obtained are of great interest, showing as they do in a reasonably quantitative manner the influence exerted on the running quality of steel by variations in the composition.

The modification in the physical properties produced by an addition of 1 per cent. of copper to a number of carbon and alloy cast steels, also the response of these copper-bearing steels to a temper-hardening treatment, are shown in Section III, contributed by Mr. Martin Alexander, of the Research Department, Woolwich.

Little information is available concerning the physical properties of steel during its passage from the liquid to the solid state. A report of the work carried out by Mr. H. F. Hall in continuation of that published in the Second Report will be found in Section IV. A reliable method of determining the liability to hot tears during the time when the steel is cooling down in the mould would be invaluable. The results reported by Mr. Hall will therefore be welcomed as a useful contribution to the solution of this problem.

The Moulding Materials Sub-Committee, which was formed just prior to the publication of the previous Report, have now presented their first report, which will be found in Section V. The very foundation of their work is the availability of thoroughly standardised and accurate methods of assessing the moulding properties of foundry material. They have therefore devoted much attention to the examination of present methods,

and efforts are being made through a national sub-committee to set up authoritative standard test methods which will command general acceptance.

The Committee wish to record their appreciation of the continued support accorded on all sides. Special thanks are due to the General Steel Castings Association for their generous financial support of the Committee's researches.

TABLE II.—*Other Carbon Steel Heats.*

Cast No.	Chemical analysis. Per cent. C	Si	Mn	S	P	Tapping temp. Deg. C.	Temp. at end of casting. Deg. C.	Average length of "Ruff" rods. In.	Foundry remarks.
32	0.115	0.27	0.43	0.026	0.023	1,700	1,605	20.00	Hot. Very fluid.
33	0.15	0.21	1.46	0.033	0.024	1,723	1,594	14.00	Hot. Normal fluidity.
34	0.275	0.38	0.60	0.034	0.022	1,646	1,410	16.00	Normal temp. Fluid.
35	0.355	0.40	0.79	0.018	0.031	1,640	1,530	13.87	Cool. Sticky.
36	0.505	0.38	0.82	0.019	0.029	1,677	1,565	13.25	Normal temp. and fluidity.
37	0.54	0.36	0.75	0.015	0.034	1,652	1,583	16.13	Hot and fluid.

This assistance has considerably encouraged the Committee in their work.

They would also renew their thanks to Capt. H. R. Priston, R.N., Chief Superintendent of the Research Department, Woolwich, as well as to Dr. R. H. Greaves, Director of Metallurgical Research, Woolwich, for their continued help on the Committee's researches. To the Institute of British Foundrymen and the British Cast Iron Research Association the Committee express their appreciation of their continued collaboration. Grateful acknowledgment is tendered to the Department of Scientific and Industrial Research, the British Iron and Steel Federation and to the Iron and Steel Institute for financial and other help given to the Committee.

To the secretary, Mr. Headlam-Morley, and his capable staff, the Committee wish once more to acknowledge their thanks for the efficient manner in which they have carried out their work.

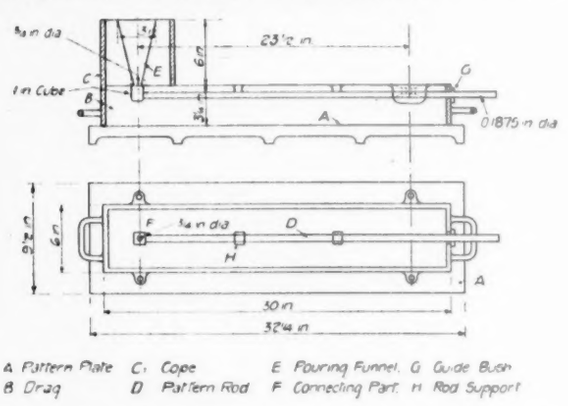


FIG. 1.—MODIFIED ARRANGEMENT FOR CASTING RUFF TESTS.

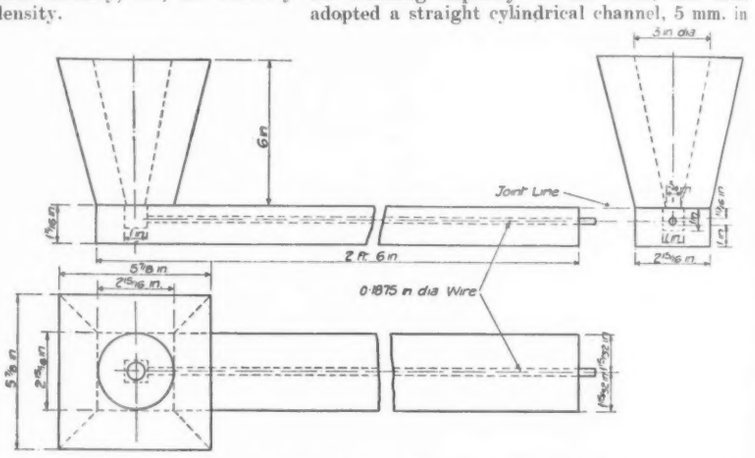


FIG. 2.—ARRANGEMENT FOR CASTING RUFF TESTS. (ADDITIONAL MODIFICATIONS.)

THE RUFF FLUIDITY TEST

Introductory Comments on the Ruff Test

Dr. W. Ruff, as a result of experiments described in the "Iron and Steel Institute, Carnegie Scholarship Memoirs, 1936," introduced a new form of test of the running quality of liquid metal. His experiments consisted first of determinations of the effect of variations in the method of running the spiral casting usually employed in fluidity testing. The results showed the necessity of a study of the principles governing the flow of a cooling stream of liquid metal in a narrow channel.

For the purpose of determining velocities of flow a special discharge method was developed, and an attempt made to deduce from the difference (δV) in the velocities of discharge (V_1 and V_2) from two tubes of the same diameter (d), but differing in length by l, first the retardation of the stream ($a = V_m \cdot \delta V/l$) and thence the "resistance index" (λ) of the pipe, a coefficient of the resistance to flow defined as:

$$\lambda = \frac{2d}{V_m^2} \cdot a = \frac{\delta V}{V_m} \cdot \frac{2d}{l},$$

where V_m is the mean velocity along the length l, *i.e.*, $V_m = \frac{1}{2}(V_1 + V_2)$, δV being $(V_1 - V_2)$.

On analogy with large-scale experiments in water pipes, a logarithmic relationship was held to exist in molten metals as well as in water, between the resistance index (λ) and the Reynolds' number (R), where $R = V_m \cdot d/\gamma$, γ being the kinematic viscosity, *i.e.*, the viscosity divided by the density.

The logarithmic λ/R diagram for water displays regions where the conditions are those of smooth flow only, of smooth flow changing to turbulent flow, and of turbulent flow only.

On applying the values of λ and R derived for liquid steel and for liquid malleable cast iron to the above-mentioned diagram, it was found that at certain velocities both these materials are subject to a tendency to change as rapidly as possible from a state of smooth flow to one of turbulent flow, a tendency which was shown, for liquid steel, to set in at a lower velocity than for liquid malleable cast iron. The increased length of run to be expected with higher velocities is thus checked by an increased tendency to turbulence which prevents the length of run from exceeding a certain maximum value. With a moderate amount of superheat, variations in the initial speed between 100 and 200 cm. per sec. were found to have little effect on the length run in a straight tube 5 mm. in dia. The dynamic laws, which limit the running capacity of the metal when certain minimum velocities are exceeded, are more directly applicable to a straight tube than to a spiral.

Assumptions made in applying the results obtained from two streams of metal, flowing continuously at different uniform velocities, to the case of a single stream coming to rest have been the subject of correspondence between the Committee and Dr. Ruff. While these assumptions are considered to invalidate any quantitative application of the numerical results to the determination of the maximum length of run, the close study made by Dr. Ruff of the factors operative in the fluidity test is of value in calling attention to the effects of turbulence in addition to the more generally recognised thermal effects which limit the running capacity by causing solidification of the metal when the supply of heat in the forward-moving stream is insufficient.

In standardising a method of actually testing the running capacity of the steel, Dr. Ruff adopted a straight cylindrical channel, 5 mm. in dia., fed through a simple form of runner by a spoon sample from the furnace.

This has been tried with slight modifications by several members of the Committee. Dr. Greaves reported some results which indicated that consistent values of the length run could be obtained in dry-sand moulds, provided that precautions were taken against unsteady handling of the sampling spoon during casting, and that the spoon was heated by being held immersed in the steel for 5 sec. before the sample was withdrawn. Samples from the Tropenas converter and from the same steel killed in the ladle indicated, in agreement with Dr. Ruff,

TABLE III.—*Alloy Steel Heats.*

Cast no.	Chemical analysis. Per cent. C	Si	Mn	S	P	Ni	Cr	Mo	Tapping temp. Deg. C.	Temp. at end of casting. Deg. C.	Average length of "Ruff" rods. In.	Foundry remarks.
38	0.93	0.34	1.01	0.021	0.033	0.14	1.65	—	1,640	1,525	12.13	Normal temp. Fluid.
39	0.835	0.30	1.06	0.014	0.036	0.16	1.76	—	1,688	1,541	14.00	Normal temp. Fluid.
40	0.84	0.36	1.02	0.012	0.031	0.15	1.66	—	1,688	1,547	14.50	Hot and fluid.
41	0.835	0.50	1.01	0.019	0.032	0.29	1.80	—	1,618	1,512	14.75	Normal temp. and fluidity.
42	0.195	0.17	0.41	0.033	0.021	2.94	0.85	0.48	1,677	1,572	15.00	Warm and fluid.
43	0.31	0.43	0.62	0.011	0.029	2.17	0.61	0.31	1,629	1,572	15.50	Cool. Normal fluidity.

that at a given temperature, the killed steel gave a greater length of run. Mr. Walker, who used a $\frac{3}{16}$-in. (4.76-mm.) dia. rod for a pattern, and moulds made from Chelford silica sand with an oil binder dried in the ordinary way in a core stove, found that the results obtained were reasonably consistent, in that duplicate experiments gave very similar results. Provided that the pouring was done at above a minimum rate and was conducted without a break, the actual head in the reservoir made very little difference to the results. If, however, the test was poured slowly, the rods obtained were much shorter in length, and if the pouring was not continuous the test was spoiled. A certain connection between the length of rods and the observed behaviour of the steels as run into the mould has been established, as will be seen by the evidence presented below, which records a large number of tests carried out independently by two separate foundries.

WORKS RESULTS USING THE RUFF FLUIDITY TEST

By T. R. Walker, M.A., F.I.C. (Sheffield).

Following the publication of the Carnegie Scholarship Memoir by Ruff,* experiments were carried out by members of both the Steel Castings Research Committee and the Steel Castings Sub-Committee of the Institute of British Foundrymen to investigate its practical utility in the actual foundry, primarily from the point of view of determining if this method of testing could be carried out to give reliable comparative figures for the running life of steel in the foundry, the tests being made while the steel was still in the furnace. Particulars of two series of

Table IV.

Foundry remarks.	Average length of rod. In.	No. of casts.	Average tapping temp. Deg. C.	No. of casts.
Cool, not fluid ..	9.75	1	1,629	1
Normal temperature, not fluid	9.5	1	1,652	1
Normal temperature and fluidity ..	12.3	15	1,654	13
Hot, normal fluidity	12.9	2	1,688	2
Hot, fluid	13.68	9	1,684	8
Normal temperature, very fluid	14.75	1	1,652	1
Hot, very fluid ..	16.87	2	1,677	1

such experiments, carried out in different foundries, are given below.

In the first foundry, tests were initially made with round rods of 5 mm. dia. as specified by Ruff, the mould being otherwise of the dimensions given in Ruff's Paper. As, however, rods of 5-mm. dia. are rarely used in England, other experiments were made to find out what variation would be obtained with rods of 0.25, 0.197 (5 mm.) and 0.1875 in. dia. The variation found was very small, and it was decided to adopt this latter size in further tests. The moulds were made from a mixture of Chelford silica sand with an oil binder and were dried in a core stove in the ordinary way. They were made one in a box, the boxes having removable sides. The arrangement is shown in Fig. 1, the pouring head being placed on the top of the mould after this has been dried in the core oven.

Experimental Method

The steel tested was made in basic electric arc furnaces of 3 and 6 tons capacity, and samples were taken in the following way: An ordinary sampling spoon was thrust into the bath, dipped into the steel and turned about till warm, then a spoonful of steel was taken half way between one electrode and the edge of the bath. The spoon was taken from the furnace, the slag quickly removed from the surface of the steel by means of a wooden stick, the spoon allowed to rest on a metal support exactly like that used by Ruff, and the steel poured steadily into the head of the test mould.

The samples were taken a few minutes before tapping. Temperatures were taken with a Hartman and Braun pyrometer, while the steel was being run into the ladle and also during the filling of the last mould. Where conditions were unfavourable, no temperature readings were taken. In addition to the record of temperatures and lengths of rod, the opinion of the foundry staff concerned with the filling of the moulds was obtained with regard to the temperature and fluidity of the metal, as it appeared to them during the casting process.

Table V.

Cast no.	Carbon. Per cent.	Alloying element. Per cent.	Pouring temp. Deg. C.*	Length of "Ruff" rod. In.	Foundry remarks.
44	0.28	—	1,575	11½	Good bed heat.
45	0.28	—	1,600	14½	Shanking heat.
46	0.26	—	1,555	11½	Bed heat.
47	0.21	Mo 0.5	1,545	11	Bed heat.
48	0.28	—	1,590	14¾	Shanking heat.
49	0.36	—	1,595	14¾	Shanking heat.
50	0.22	—	1,560	11½	Good bed heat.
51	0.24	—	1,575	14½	Good bed heat.
52	0.22	—	1,575	13½	Good bed heat.
53	0.26	—	1,575	13¾	Good bed heat.
54	0.42	—	1,545	15	Bed heat.
55	0.27	—	1,575	12¼	Good bed heat.
56	0.24	Mo 0.5	1,540	7	Bed heat.
57	0.28	—	1,525	9¼	Bed heat.
58	0.27	—	1,590	17½	Bed heat. Hot.
59	0.29	—	1,575	14½	Bed heat.
60	0.21	—	1,565	14	Bed heat.
61	0.23	—	1,555	12¼	Bed heat.
62	0.27	—	1,575	15½	Bed heat. Hot.
63	0.25	—	—	13½	Bed heat.
64	0.20	—	—	11¼	Bed heat.
65	0.24	—	1,575	14½	Bed heat.
66	0.24	—	1,565	12¼	Bed heat.
67	0.20	—	1,565	11	Bed heat. Cold.
68	0.28	—	1,590	14¼	Shanking heat.
69	0.21	—	1,555	11½	Bed heat.
70	0.24	—	1,590	16¼	Bed heat. Hot.
71	0.19	—	—	14¾	Good bed heat.
72	0.22	—	—	14¾	Shanking heat.
73	0.22	—	—	12	Bed heat.
74	0.23	—	—	16½	Shanking heat.
75	0.21	—	—	11¾	Bed heat.
76	0.25	—	1,575	14½	Good bed heat.
77	0.18	—	—	15½	Shanking heat.
78	0.18	—	—	8¾	Bed heat. Cold.
79	0.22	—	—	13½	Bed heat.
80	0.28	—	—	14½	Bed heat.
81	0.29	—	1,575	14½	Good bed heat.
82	0.26	—	—	14	Bed heat.
83	0.20	—	—	12	Bed heat. Cold.
84	0.28	—	—	13½	Bed heat.
85	0.26	—	—	15	Good bed heat.
86	0.21	—	—	9	Bed heat. Cold.
87	0.24	—	—	13½	Bed heat.
88	0.25	—	—	15½	Shanking heat.
89	0.18	—	—	14	Bed heat.
90	0.22	—	—	14	Bed heat.
91	0.25	—	—	13	Bed heat.
92	0.19	—	—	13½	Bed heat.
93	0.18	—	—	15½	Good bed heat.
94	0.30	—	—	14½	Good bed heat.
95	0.16	—	—	14	Shanking heat.
96	0.21	—	—	12	Bed heat. Cold.
97	0.39	—	—	12¾	Bed heat.
98	0.22	—	—	12½	Good bed heat.
99	0.25	—	—	9	Bed heat. Cold.
100	0.20	—	—	13	Good bed heat.
101	0.22	—	—	11	Bed heat.
102	0.24	—	—	11½	Bed heat.

* Temperatures are actual readings plus 8 per cent.

Results from Foundry No. 1

The results of a number of tests from soft carbon (0.20 to 0.23 per cent.) steel for castings are given in Table I, and from carbon steels with other carbon contents in Table II. The figures from a small number of alloy steels are shown in Table III.

The data of Table I have been divided into groups based on the remarks of the foundry staff, the average tapping temperature and length of rod being taken for all casts receiving the same foundry verdict; the results obtained are shown in Table IV.

It will be seen that when the figures are arranged in this way there is general agreement between the foundry workers' verdict, the average tapping temperature and the average length of the "Ruff" rod. There is, however, considerable variation in the figures given by different casts receiving the same foundry verdict and therefore included in the same group.

The temperatures given in the above tables are corrected figures, the actual readings having been corrected according to instructions supplied by the makers of the pyrometer. The tapping temperatures have all been taken by the same staff using the same pyrometer, so that they may be regarded as comparative figures obtained under similar conditions, but caution is necessary in any attempt to correlate them with temperatures obtained in other works or in laboratory experiments, where the conditions of the steel and other factors may be different. The temperatures taken at the end of casting and recorded in the above tables are of no value in assessing the utility of the Ruff fluidity test, since the length of time that the steel is held in the ladle and therefore the fall in temperature of the steel depend on many factors, such as the size and number of the moulds to be filled and their positions on the foundry floor. These factors are different for almost every cast, and the temperatures taken at the end of the casting should therefore be regarded as having been included for purposes of information only.

Data from a Second Foundry

In the second works, further minor modifications were made in the method of preparing the test mould, this being intended to lower the cost of producing the mould without altering the results obtained from a given cast of steel. The dimensions of the mould used are given in Fig. 2, which shows that the width and depth of the mould have been made substantially smaller than in Fig. 1, thus considerably reducing the amount of sand required to make the mould.

Table VI.

Foundry remarks.	Average length of rod. In.	No. of casts.	Average pouring temp. Deg. C.	No. of casts.
Bed heat. Cold ..	10.29	6	1,565	1
Bed heat	12.57	27	1,552	11
Good bed heat ..	13.62	14	1,571	8
Shanking heat ..	14.97	9	1,594	4
Bed heat. Hot ..	16.25	3	1,585	3

The steel tested in this foundry was all melted in a basic electric arc furnace. In taking a sample of steel from the furnace for test, a cold spoon was dipped into the bath and moved about, and a sample was drawn from a position mid-way between the electrodes and the back wall of the furnace. It was then cleared of slag, and the test rod was poured immediately by resting the spoon on the runner box. In every case the remarks of the foundry staff concerned with filling the moulds were noted. In a number of cases, pyrometer readings were taken on the stream from the bottom of the ladle during the pouring of the first mould. These temperatures were taken by means of a Foster optical pyrometer, and were corrected by the addition of 8 per cent. of the observed reading. The results are given in Table V.

The data of Table V have been divided into groups based on the remarks of the foundry staff, the average pouring temperature and length of rod being taken for all casts receiving the same foundry verdict; the results obtained are shown in Table VI.

Here again there is general agreement between the foundry workers' verdict, the average pouring temperature and the average length of the

* "Iron and Steel Institute, Carnegie Scholarship Memoirs," 1936, Vol. 25, p. 1.

"Ruff" rod. It must, however, again be admitted that there is considerable variation in the figures given by different casts receiving the same foundry verdict, and therefore included in the same group.

The temperatures recorded in the second works are of a lower order than those of the first works, but the higher temperatures of the first works were taken on the steel issuing from the furnace, whilst those of the second works were taken on the stream running into the first mould filled.

The comments made above regarding the tapping temperatures obtained in the first works can be generally applied to those recorded in Table V. In the latter case it is also to be remembered that the length of time elapsing between the tapping of a furnace and the filling of the first mould varies appreciably from cast to cast. The different falls in temperature thus introduced make it impracticable to estimate with any accuracy what would be the corresponding temperature of the steel in the furnace immediately before tapping.

It is interesting to note that the range of the average length of the "Ruff" rods is somewhat similar in the two works. In both cases further tests are being carried out, as the results so far obtained offer some promise that this type of test will ultimately prove valuable in ensuring that a given cast of steel is made suitable for foundry purposes before being tapped and sent into the foundry.

Statistics of the Iron and Steel Industries

The British Iron and Steel Federation, Steel House, Tothill Street, London, S.W.1, have just issued the 1938 edition of their invaluable and comprehensive publication: "Statistics of the Iron and Steel Industries, for the Year 1937" (price 10s. 6d. post free), which although following fairly closely on the general lines of these volumes during the preceding seventeen years has been amplified by further useful tables and data. The new tables number thirteen, of which five apply to the United Kingdom, *viz.*, imported iron ore consumed in the production of pig-iron and ferro-alloys, by district of consumption and country of consignment, 1937; materials consumed in the production of pig-iron and ferro-alloys, by district, 1937; materials consumed in the production of steel ingots and castings, by district, 1937; imports of iron and steel scrap by port of entry, 1929 and 1934 to 1937; and exports of iron and steel scrap by port of departure, 1929 and 1934 to 1937. Three tables give Brazilian statistics, *viz.*, production of pig-iron, steel ingots and castings, and rolled iron and steel products in 1925, 1930, and 1933 to 1937; imports of iron and steel by product and country of consignment, 1937; and imports of iron and steel by products in 1929 and 1933 to 1936. The tables for Czechoslovakia are amplified by a further table showing the imports of iron and steel by product and country of consignment, 1937, and the Canadian tables by two additional tables giving exports of iron and steel by product in 1929 and 1934 to 1937, and exports of iron and steel by product and country of destination in 1937. The statistical section covers 41 countries and contains 278 tables, while the whole volume now stretches to the imposing total of 306 pages.

The Tariff Section now includes a schedule of all changes in the United Kingdom import duties since 1932 and of White Papers issued describing the circumstances of such changes, the progress of reconstruction, the International Cartel Agreement, the report on the present and future development of the industry, and other key documents. The usual information is also given regarding import duties on iron and steel in force on September 26, 1938, in the United Kingdom and in foreign countries.

Notes from the Branches

FALKIRK SECTION

The Falkirk Section of the Institute of British Foundrymen opened its winter session with a "smoker" and social on October 14. The President of the section, Mr. R. R. Shaw, extended a cordial welcome to the company, among whom were a few new faces. Thereafter, the proceedings were carried through in a light and happy vein, with slight diversions for the speeches, which struck a more serious note.

The toast of "The Falkirk Section" was proposed by Mr. T. Tyrie, B.Sc., of the Foundry Technical Institute, Falkirk. Mr. Tyrie spoke of his recent arrival in the district as successor to Mr. H. Cowan, and expressed gratitude to the members of the foundry industry in Falkirk for the kindly way in which they had received him. The Institute, he proceeded, had had a useful life extending to over 35 years, its influence for good in the foundry industry in particular, and in engineering in general, having undoubtedly been most marked. The membership reached over 2,000, of which the Scottish Branch could claim about 300. The scope of the Institute's work was wide, and its success as a whole depended largely upon the enthusiasm of the Branches and Sections, and he was glad to note that that enthusiasm was prominent at all meetings of the Falkirk Section.

The reply was given by Mr. J. A. Donaldson (senior Vice-President of the Section), who assured Mr. Tyrie that he would find his new surroundings very congenial. In the course of his remarks, Mr. Donaldson alluded to the appointment of their late President, Mr. N. A. W. Erskine, as President-Elect of the Glasgow Branch.

Mr. Erskine suitably replied.

During the evening Mr. James M. Primrose (managing director of the Grangemouth Iron Company, and a Past-President of the Falkirk Section) spoke of present trade conditions in the light castings industry. His remarks are published on another page in this issue.

The proceedings included songs and stories contributed by members of the gathering, and artistes and chairman were thanked on the proposal of Mr. T. Cunningham, seconded by Mr. A. Ure.

Dr. Donaldson's Address

Dr. J. W. Donaldson, D.Sc., of the Scotts' Shipbuilding & Engineering Company, Limited, Greenock, delivered the first of the new session's series of lectures to the Section on October 15, his subject being "The Technical Committee and Its Work." Mr. R. R. Shaw (President) was in the chair.

Dr. Donaldson commenced his lecture by stating that he had been a member of the Technical Committee of the Institute since its inception in 1930, when it succeeded the old Test Bar Committee appointed to examine the testing of cast iron. While dealing with technical matters peculiar to foundrymen, the Technical Committee also acted as a connecting link between the Institute and other technical societies. Moreover, it collected all technical information with a view to publication, and carried out investigations and research work. Dr. Donaldson then described the constitution of the Technical Committee, and how its work was divided among various sub-committees.

The speaker stressed the voluntary nature of the Committee's activities. "Last year," he said, "about fifty meetings were held, and the members travelled at their own expense. In fact, all the work of the Technical Committee is done voluntarily, and members of the Institute should appreciate this."

He pointed out that the work of the Committee was divided into two sections—the General Section and the Sub-Committee Section. In 1932, an inquiry bureau was established under the general activities, and here were recorded all the problems received. The General Secretary of the Institute analysed these inquiries and sent the problems to an appropriate sub-committee for advice. Thus the two sections were always in complete co-operation.

Another little-known activity of the Committee to which Dr. Donaldson drew attention was the determining of certain terms used in foundry nomenclature. He pointed out that certain terms had different meanings in different foundries—such words as "blowhole," "tear," "sink," "casting crack," "draw," etc. The Technical Committee were collecting information on all these words with a view to issuing a clear definition of each. The work was not yet completed, but it was hoped to have the results published in the near future.

In other directions of its work, the Technical Committee worked in harmony with other technical bodies in America and on the Continent.

In conclusion, Dr. Donaldson referred to the activities of the special sub-committees, particularly the Cast Iron, the Non-Ferrous, and the Steel and Malleable.

Mr. J. A. Donaldson (senior Vice-President of the Section) brought the meeting to a close by proposing a vote of thanks to Dr. Donaldson.

LINCOLN SECTION

The Lincoln Section of the East Midlands Branch held their opening meeting on October 17, with Mr. E. C. Carrott (Vice-President) in the chair. The number of members present was well above the average, the occasion being an address by the President, Mr. G. L. Harbach, who took for his subject "Pig-irons and Foundry Mixtures."

Mr. Harbach enumerated the different types of pig-irons available, according to the districts in which they were produced and their relative phosphorus contents, which placed them in order of cost—the higher the phosphorus the lower the price. The grading of pig-irons according to fracture was also dealt with, and it was shown that whilst the silicon content was the principal controlling factor for any particular brand of pig-iron, so many other factors affected the appearance of fractures that they could not be accepted as reliable indications of silicon content, or their probable effect as regards the softening or hardening of a mixture. Examples of fractures varying from No. 2 to No. 4 in one brand of pig, all with 2.7 per cent. silicon, were shown to illustrate this point, and it was stressed that purchase on the basis of analysis was essential if consistent results were to be expected from different mixtures.

The effects of the different elements on casting and mechanical properties were then dealt with, and the adjustment of silicon and carbon contents to suit different section thicknesses and to yield different strengths was demonstrated by a series of slides.

The speaker, who has been in close touch with the preparation of the Cast Iron Sub-Committee report on "The Properties of Cast Iron," then briefly dealt with the main points in the report, and, in consideration of requests by various members for mixtures to suit the different grades of cast iron now required by B.S.I. specifications, specimen mixtures were given for each grade and a few practical hints with regard to the difficulties in producing and handling the higher strength grades in the foundry.

It was decided that as the subject was of such general interest, contrary to usual practice discussion was invited, and this resulted in useful and interesting contributions from Mr. Carrott, Mr. Dunleavy, Mr. Mather, Mr. Gladwell, Mr. Hartley and Mr. Cavill, to which the speaker responded.

The vote of thanks, proposed by Mr. Dunleavy and seconded by Mr. Mather, was cordially endorsed by the meeting. The President, in reply, expressed his pleasure at seeing so many present and the appreciative reception of the address.

Refinement of the Structure of Castings*

A GENERAL REVIEW OF THE PRESENT SITUATION

By Prof. A. PORTEVIN (Director, École Supérieure de Fonderie)

If the foundryman's art be considered in its broadest aspects, it may be said that it amounts to satisfying three conditions:—

(1) The casting should conform to the pattern; that is to say, it should have the required dimensions and should reproduce the shape in its smallest details. This is a problem which concerns running power and shrinkage.

(2) The casting should be free from macroscopic and microscopic defects in order to secure the maximum compactness and continuity of the material. This is a problem which involves all the phenomena and all the properties and factors pertaining to foundry practice.[1]

(3) The casting should have a fine structure, the latter corresponding most frequently to the optimum mechanical properties and being in addition necessary for good efficacy of the heat-treatments. This is a metallurgical and metallographical problem requiring a knowledge of the phenomena and laws of solidification and transformation, in view of the fact that, in the case of castings, the necessity for preserving the shape prohibits the application of mechanical grain-refining processes by deformation preceding or accompanying a heating or annealing, that is to say, refining by mechanical cold or hot treatment (forging or rolling).

In short, the first problem aims at obtaining the *shape* of the casting; the second aims at obtaining the *total strength*, and the third aims at obtaining the *specific strength*.

In previous Papers[1] the author examined the first two problems as a whole, the running power and the factors and phenomena of foundry practice being studied. It was therefore thought that it would be opportune to consider on this occasion the third problem, namely, that of the refinement of the structure, in view of its topical character. This will not be so much a personal contribution as a general review collating the ideas and data which have been acquired in order to provide the starting point and basis for a general discussion, which, as far as the author is aware, has never yet been done in a Foundry Congress.

Two Basic Considerations

Actually, there are two cases to be considered:—

(1) After solidification, the alloy does not undergo any polymorphous transformation permitting the refinement of the structure by a regenerative heat-treatment. In its general outline, the structure remains that of solidification. This is the general case of foundry alloys other than the steels proper. Among the ferrous alloys, this general case includes the ferritic steels and austenitic steels. In this case, refinement of the structure must be effected at the time of solidification.

(2) In the solid state, the alloy undergoes a polymorphous transformation permitting regenerative heat-treatments. It is therefore necessary to refine the structure either during solidification as before or during the transformation by heat-treatment. The study of this structure refinement by regenerative heat-treatment of steel castings would warrant a special discourse of itself and would lead too far. Therefore the subject will in general be confined to the main outlines, but more detailed attention will be given to the refinement of the solidification structure both for steels and for cast irons and other foundry alloys.

* French Exchange Paper given to the Polish International Foundry Congress.

BASIC PRINCIPLES OF THE SOLIDIFICATION STRUCTURE

When a molten alloy solidifies, that is to say, crystallises, crystallisation centres or nuclei are formed in the liquid and develop simultaneously with the formation of fresh nuclei in the liquid. There are three characteristics to be considered:—

(1) External *form* (facies) of the crystals during their free growth, that is to say, while they are surrounded by liquid.

(2) *Number* per unit volume and consequently *mean size* of these crystals.

(3) Mutual *orientation* and relative dimensions of the crystals.

1. Facies or Form of the Crystals

The facies or external form of the primary crystals is retained in the solidified alloy only if the primary solidification is interrupted by eutectic solidification, the formation of the eutectic arresting the development of the pro-eutectic crystals and fixing them in position by cementing them. If there is peritectic reaction, the growth of the primary crystals is likewise arrested, but their initial form may be altered in consequence of the peritectic reaction of these crystals on the surrounding liquid.

On the other hand, in the very frequent case among industrial alloys (steels, alpha brasses and bronzes, aluminium light alloys) where the growth of the primary crystals proceeds to the end of solidification, the facies of the crystals disappears in consequence of their mutual limitation, giving an agglomerate of grains or crystals of indefinite external form limited by curved facets having no precise connection with the crystal lattice. (In this case, the facies is observed by interrupting the crystallisation by pouring off the residual liquid).

The facies has thus only very rarely any importance from the point of view of the final structure, since it disappears in the course of solidification. It has, however, to be taken into consideration in studying the phenomena which accompany solidification: segregation, microscopic shrinkage cavities, etc. Furthermore, two broad categories of facies may be distinguished in the primary crystals.

(*a*) Ramified, arborescent or dendritic facies to be found in primary solid solutions or extreme phases of the diagrams and having the crystalline structure of one of the component metals.

(*b*) Concave polyhedric facies to be found generally in the case of definite compounds or intermediate phases of the diagrams and having a crystalline structure different from that of the component metals.

The passage from one to the other of these two categories of facies may furthermore be effected by modification of the factors of crystallisation, addition of foreign elements, variation of the viscosity of the liquid and modification of the rate of cooling.

The facies is dependent upon the surface tension. According to the value of the latter relatively to that of the cohesion (or hardness) of the crystals, the forms are rounded (as for example with copper) or have sharp edges (as for example with antimony).

2. Number and Mean Sizes of the Crystals

In crystallisation, there are two simultaneous phenomena characterised by two distinct magnitudes:—(*a*) The spontaneous formation of crystallisation centres defined at a given temperature by what Tammann has called the power of spontaneous crystallisation or number of nuclei (Kernzahl K*z*) and which may be called the rate of formation or the number of crystallisation centres N*c* formed in unit time and in unit volume of the liquid; and (*b*) the growth of the existing crystals which Tammann defines by the linear crystallisation velocity (Kristallisationsgeschwindigkeit K*g*) and which will be called rate of growth V*c* or increase in dimensions per unit time.

These two magnitudes N*c* and V*c* depend upon the factors of crystallisation, temperature, degree of superfusion, composition of the liquid, etc., and they both influence the final magnitude g or the number n of crystals per unit volume $\left(g = \frac{1}{n}\right)$. The fineness of structure n increases directly with N*c* and inversely with V*c*.

Thus, the study of the variations of n amounts to that of the variations of the two elementary magnitudes N*c* and V*c* and of the variables affecting the latter.

N*c* is understood in the absence of pre-existing or added nuclei. It is the *spontaneous* power of crystallisation. Foundrymen are familiar with the important part played in the cessation of undercooled or supersaturated states by particles of crystallised substances which when introduced immediately produce crystallisation, the latter proceeding at the rate V*c*. Each particle plays the part of a centre or nucleus of crystallisation. This part is likewise played not only by particles of isomorphous substances, but by any solid particles, dust, solid precipitates existing or introduced in the liquid and even by gaseous particles or bubbles (example of saline solutions), particularly for materials having small numbers N*c* of centres of spontaneous crystallisation (for example, the experiments of J. Meyer and W. Pfaff on thymol, salol, and benzophenone).

The nature of the particles would appear to be able to play a part. Tammann and Buchner have shown that the crystallisation of ice was accelerated by the addition of iron wire or powdered silica glass by increasing the number of nuclei, while the addition of corundum powder had no effect. Hence, the part played in solidification by the presence of "inclusions."

Furthermore, solid particles in suspension, particularly if they are in the form of films or membranes floating in the liquid, may fundamentally act on the growth of the crystals, that is to say they may modify artificially the effect V*c* by forming a material obstacle to the development of the crystals. The rate of growth is particularly influenced, however, by the substances dissolved in the liquid. This action depends upon the effect on the viscosity and diffusion (function of the molecular weight) and on the lowering of the melting point.

In the experiments of Tammann and Buchner on the rate of crystallisation of ice, the latter generally diminishes when the concentration of foreign matter dissolved in the water is increased, but at very low concentrations it is found that the crystallisation velocity is increased by their influence. A maximum is observed (example of the additions of NaCl, HCl, NaOH).

Thus, a modification in the concentration of the alloy or the addition of a foreign element to the liquid and more generally the action of any factor may be complex and may act:—

On N*c* directly by modifying the power of spontaneous crystallisation or artificially by determining the presence of nuclei or inclusions in the liquid.

On V*c* either directly by modifying the rate of growth or artificially by determining the formation of solid films or laminæ forming an obstacle to such growth.

As will be seen, existing knowledge of the factors of crystallisation are deduced from examples borrowed from transparent or translucent sub-

(*Continued on page* 312.)

Chemical Changes of Cast Iron in Cupola Melting

DISCUSSION AT BRADFORD

The West Riding of Yorkshire Branch of the Institute of British Foundrymen, meeting at Bradford Technical College on October 8, discussed the American Exchange Paper by DR. J. T. MACKENZIE on "Chemical Changes of Cast Iron in Cupola Melting." In the absence of the author, the Paper was submitted by Mr. H. Forrest (Immediate Past-President of the Branch). Mr. A. S. Worcester (Branch-President) occupied the chair.

MR. FORREST first explained that Dr. Mackenzie's Paper had been intended for delivery at the Institute Conference at Bradford in June last, but some delay in transit occurred in regard to the slides, and the Paper was therefore not presented except formally. The Council of the West Riding Branch felt it would be an acceptable contribution to the Branch programme, and had secured permission to submit it, along with the slides. The Paper was published in THE FOUNDRY TRADE JOURNAL of July 21, 1938.

MR. H. A. MACCOLL (Bradford), referring to the causes of carbon pick-up, suggested that some of the points raised could probably be explained solely on surface area of the coke available. That would explain the increase in carbon pick-up with small coke and the increase of sulphur pick-up, but it did not explain, to the speaker's mind, why the silicon loss should be greater with the large coke.

MR. FORREST, in reply, said the author had pointed out that with the large coke the effect of the blast would be greater and gave rise to more severe oxidation. He, too, thought there was a good deal in what Mr. MacColl suggested as surface area of the coke being the governing factor.

Silicon Control

MR. F. K. NEATH said the tests related in the main to a type of hematite iron—an important matter. In melting hematite the conditions were so different that it was difficult to draw accurate conclusions. A point the author made was that for the first seven or eight taps of the cupola the question of the silicon, carbon, etc., was not uniform, but after those taps it became more or less so. For the early taps, the coke would be pure virgin coke. Then it became changed, with a covering of molten iron slag, and operations became more difficult. The surface of the coke became more neutral or "dead," and that might well explain the phenomenon the Paper mentioned. In view of the high coke bed one would like to know what was the experience of silicon loss under conditions of a deep bed and possibly intense temperature and high carbon content. He felt that silicon losses under those conditions should not be very great.

MR. S. CARTER (Senior Vice-President) said his own experience suggested to his mind that this phenomenon was due entirely to thermal conditions. In regard to the carbon pick-up on steel scrap, his experience was that the steel-mix irons picked up more carbon, but if one were using intermittent thick and thin steel one would have to adjust the blast to suit the material.

MR. ROPER (Keighley) said his own experience was that the burning condition was more allied to its physical condition. It was obvious that steel mixtures were used by the author of the Paper. If steel scrap were to be melted properly, there must be a heavy bed of fusion coke. With a light steel scrap a lower bed was satisfactory. The conditions and the freedom with which the blast associated with the molten iron had more to do with the matter than the coke. Personal experience was that the height of the bed from the change of the metal due to holding up the bed had very little influence on the metallurgical conditions.

Carbon Control

MR. FORREST then quoted extracts from Bamford's work which suggested that control of the carbon content in the iron lay fundamentally in control of the height of the bed, quality and size of the coke, and quality of the metal scrap.

MR. NEATH suggested that an interesting way of proving the matter over a reasonable length of time would be to make a bed of big coke and let no small coke come into it until later.

MR. FORREST said he had made the reverse experiment, and found the small coke came down. He scouted the desirability of charging with large coke. The lesson to be learned from all this seemed to be largely that much depended on the origin of the coke. The main value of the Paper seemed more in the direction of useful pointers than in attempting to follow all these things in a general way.

Influence of Furnace

MR. W. PARKER (Past-President) gave an experience of his own with two cupolas working side by side—one only half the size of the other, one of the latest type and the other old, and both giving the same class of metal in analysis. How was that to be explained?

The PRESIDENT (Mr. Worcester) said he had a somewhat similar experience, but with three furnaces—a 5-ton cupola with receiver, a 7-ton ordinary straight furnace, and the third one with a deep bed underneath, and all gave the same analysis in the product.

MR. NEATH remarked that some years ago the Germans did some work which was published in this country, and which was also confirmed here, and they had come to the conclusion that with a given set of cupola conditions, the total carbon content would be the same after a certain number of melts, high or low, no matter what the original charge was. That was an interesting point—though he admitted it only seemed to make the problem more involved.

Ash Content

MR. MACCOLL said the Paper indicated that in general the ash content was a large factor. He could understand that a very low ash might give a very high oxide, in which one would perhaps expect reduction of carbon again; but this Paper gave the reverse suggestion. His chief criticism was that the author had presented a set of facts or statements, but did not say why he had arrived at the conclusions.

MR. FORREST pointed out that Dr. Mackenzie apparently considered the change was entirely physical.

MR. BLAKISTON said that to evaluate the Paper one should remember that knowledge of the conditions under which these cupolas worked was essential. The bulk of American conditions were very different from those in this country. They had a low hearth and tapped out as often as they could. Another condition might be that they were very short of pig-iron, and therefore might also be short of coke, which was associated with pig-iron, and probably were running mostly or mainly on petroleum coke. The height of the stack also and various local cupola conditions would be very different from British conditions. The author might perhaps have elaborated this point, so that if a high carbon was required then the blast must be controlled, using an exceptionally low pressure. In fact, this was contrary to the latest research results that the largest reaction was obtained from the higher heat.

Votes of thanks were then accorded to Dr. Mackenzie and Mr. Forrest.

Refinement of the Structure of Castings

(*Continued from page* 311.)

stances, organic substances and preferably those having a slow crystallisation permitting the phenomena to be observed and measured. For metals and alloys, the study is much more difficult owing to their opacity, their narrow range of undercooling and the relatively high crystallisation velocities. Excepting a few ingenious determinations, particularly those of the crystallisation velocity of fusible metals by Czochralski, one is restricted for the present to the final examination, that is to say, of the number n of the crystals and their dimensions and relative orientations after total solidification, without knowing for the most part the function of the respective variations of Nc and Vc in this final result.

Thus for metals in general and apart perhaps from a few exceptions,[2] the number n of crystals or grains, that is to say the *fineness of the structure, increases with the rate of cooling.* For example, the rapid solidification of an alloy along a cold wall produces a very fine structure, the thin outer surface layer of ingots.

3. Orientation and Dimensions of the Crystals

In the case of quiescent solidification without agitation of the liquid, there are two typical circumstances to be considered:—

(1) If the temperature is approximately uniform throughout the entire mass (almost isothermal cooling, zero or very small temperature gradient), the crystals are formed simultaneously throughout the entire extent of the liquid without preferred orientation, and they grow uniformly in all directions. The result is a structure having grains of substantially uniform size, disorientated and approximately equally developed in all directions (equi-axial or isometric crystals or grains). This is approximately the case of ingots cast in dry-sand or hot moulds.

(2) If at a given instant there are considerable deviations of temperature in the mass (distinctly anisothermal cooling, considerable temperature gradient), the crystallisation centres are first formed in the coolest regions, and the crystals spread thence in the direction of the hotter regions as cooling proceeds. The crystals extend and are orientated normally to the isothermal surfaces.

This is the case of the outer zone of ingots called zone of basaltic crystallisation, parallel crystallisation, orientated crystallisation or transcrystallisation, starting from the surface or thin layer of very fine crystallisation and extending towards the interior for a variable thickness, which may extend to the centre of the ingot.

The author has discussed these phenomena elsewhere[3] and has shown how, according to the macrostructure on the basis of the distribution and size of the zones of coarse crystallisation and orientated crystallisation, it is possible to recognise the method of feeding the castings and the arrangement of the chills.[4] Recently, L. Northcott[5] has utilised the examination of the orientated zones for determining the influence of additions on the crystallisation velocity of copper.

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1 A. Portevin, "Metallography and Foundry Practice," Paper read to A.T.F. on December 5, 1931 (Bull. A.T.F. 1932, **6**, 19); "Present Position of the Study of the Running Power of Metals and Alloys," 4th World Foundry Congress, Paris, September, 1932; "The Function of the Laboratory in Foundry Practice" (Bull. A.T.F., 1935, **11**, 236); "Control of Casting Properties" ("Metal Progress," 1935, **27**, 47; Bull. A.T.F., 1935, **9**, 236).

2 According to Bekier, n increases for antimony when the rate of cooling increases.

3 A. Portevin. "La cristallisation et la Structure des Alliages" ("Crystallisation and Structure of Alloys"), Bull. Chim. France, 4th Series, 1927, 41, 961.

4 A. Portevin. "Etude de la Macrostructure des Métaux et alliages non ferreux et ses applications en fonderie" ("Study of the Macrostructure of Non-ferrous Metals and Alloys and its Application in Foundry Work"). Paper read at the International Foundry Congress, Paris, Sept., 1927 (Bull. A.T.F., Sept., 1927, 305).

5 "The Influence of Alloying Elements on the Crystallisation of Copper." Monthly Journal of the Institute of Metals, 1938, **4**, 9.

(*To be continued.*)

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Institute of British Foundrymen

MR. L. W. BOLTON'S ADDRESS TO BIRMINGHAM BRANCH

The new session of the Birmingham, Coventry & West Midlands Branch of the Institute of British Foundrymen was opened on October 14, when the Presidential address was given by Mr. L. W. Bolton, A.M.I.Mech.E. Subsequently Mr. G. L. Harbach presented the Report of the Cast Iron Sub-Committee upon the Properties of Grey Cast Iron.

At the outset Mr. G. W. Brown took the chair in the absence of the Past-President, Mr. H. J. Roe. After expressing regret at the inability of Mr. Roe to be present, MR. BROWN informed the meeting that, recently, the death had occurred of a gentleman who was President of the Branch some years ago, Mr. D. H. Wilkinson. He suggested that the Secretary should be empowered to send a letter of condolence to his widow and family. Mr. Wilkinson was undoubtedly held in high esteem and was a most capable foundryman.

The meeting endorsed the Chairman's suggestion.

Pointing out that it was necessary to elect another member to the General Council, Mr. Brown said that during the latter part of last year the Branch passed through a painful upset owing to the death of Mr. W. J. Molineux, which reduced their membership of the Council. Mr. Blythe automatically became Junior Vice-President, and so his place had to be filled. He proposed that Mr. E. C. Dickinson be elected a member of the Council.

This was seconded and duly passed.

In introducing Mr. L. W. Bolton, the new President of the Branch, Mr. Brown said all would feel proud and pleased that he was filling that office, not only because of his charming personality, but above all by reason of his technical abilities. He had served the Branch whole-heartedly for many years, having acted for a long period as Secretary. A more capable and worthy secretary he did not suppose it would ever be their privilege to secure. The position he held gave him not only local and national esteem, but following his journeys in recent years, international note.

MR. BOLTON, in thanking the members for the honour they had conferred upon him, said he felt particularly honoured, because the Branch was not only the Senior Branch of the Institute, but the area it covered had been associated from the earliest days with the development of the ironfounding industry. The cupola furnace was, and probably always would be, the most important melting furnace in the iron foundry, and the first man to re-melt pig-iron and scrap did so in that district. He referred to John Wilkinson, of Broseley. More recently Prof. Turner carried out research work at Mason's College, which afterwards became Birmingham University, which research work laid the foundations of scientific ironfounding. It could, therefore, be justly claimed that the area covered by the Branch had played a leading part in the development of modern ironfounding.

Mr. Bolton then gave the members the benefit of his experiences on the Continent and in U.S.A., dealing with the plant and equipment, the prevailing conditions, and the practices of ironfounders in the various countries. In conclusion he remarked that in attempting to compare the art of founding in different countries the quality of the labour available was one of the most important points. In his opinion, the British workman had no superior for sound commonsense, good judgment, and good workmanship. Whether that superiority in skill would continue obviously depended upon whether young men were trained to take their places as time went on. That problem was receiving more attention on the Continent and in America than it was in this country. However, under the conditions prevailing here he thought we could hold the lead in that respect which we now possessed.

MR. J. J. SHEEHAN, in proposing a vote of thanks to Mr. Bolton for his address, remarked that, having spent a good deal of time in the United States and in various foundries here, some of the comparisons given by Mr. Bolton would prove to their mutual advantage. We could learn something from methods adopted in other countries, and they could learn something from our methods.

In seconding, MR. G. R. SHOTTON complimented Mr. Bolton not only on his subject matter, but also on the way he had prepared and delivered his Presidential address. Comparisons were illuminating, and many of his remarks were consoling to the audience. The conditions prevailing in Continental and American foundries were often rammed down their throats as being superior, and it was consoling to hear that while in many respects they were admirable, in other ways we had advantages which systems in other countries did not possess.

Introducing Mr. Harbach and asking him to present the Cast Iron Sub-Committee's Report upon the Properties of Grey Cast Iron, MR. BOLTON explained that he was deputising at short notice for Mr. P. A. Russell, B.Sc., Convener of the Committee. The subject, however, was dear to Mr. Harbach's heart, and in addition he had carried out a great deal of work for the Sub-Committee, and was recognised as an authority on the subject.

Following the presentation of the Report a discussion took place, and on the proposition of MR. WYNNE, seconded by MR. J. HIRD, a hearty vote of thanks was accorded Mr. Harbach.

At the conclusion of the meeting the President announced that it had been proposed to arrange a works visit during October, but with so many foundries engaged in connection with the rearmament programme, it proved difficult to arrange this. Immediately arrangements had been made for this visit members would be advised.

The Institute of Vitreous Enamellers

CONFERENCE NEWS

The fifth annual conference of the Institute of Vitreous Enamellers opens in London to-morrow (Friday) afternoon at the Hotel Normandie, Knightsbridge. There is one alteration in the programme as outlined in our issue of October 6. In place of a works visit on Saturday morning, October 29, another technical session has been arranged, and this will allow of the presentation and discussion of a second Paper. This contribution is on the subject of "An Investigation into the Use of Metallic Abrasives," the authors being Mr. W. Todd and Mr. J. E. Hurst. The other Paper deals with "Scientific Aids to Control in Vitreous Enamelling," and is by Mr. J. G. Pearce and Dr. G. T. O. Martin.

As we close for press we understand that a company of about 160 will be present at the banquet to-morrow evening. The President (Sir Harold Hartley) with Lady Hartley will receive the guests, and several distinguished guests have accepted invitations to be present, among them being Sir David and Lady Milne-Watson, Sir Hugh Elles and Miss Elles, Prof. and the Hon. Mrs. Egerton, and Sir William and Lady Larke.

A full report of the Conference will be published in the Vitreous Enamelling Supplement of next week's JOURNAL.

Symposium on Steelmaking

USEFUL VOLUME AVAILABLE

The Iron and Steel Institute has issued Special Report No. 22, "Symposium on Steelmaking (Acid and Basic Open-Hearth Practice"), containing the Papers read and the discussions which took place during the symposium held in London, May 4 and 5, 1938.

The following are the contents of the volume:—

Preface.—By R. PERCIVAL SMITH (Chairman of the Open-Hearth Committee of the Iron and Steel Industrial Research Council).

Glasgow District.—"Basic Open-Hearth Practice in Scotland," by J. G. FAIRGRIEVE and J. GIBSON; "The Manufacture of Plain Carbon Acid Steels," by J. M. FERGUSON, Ph.D.; "Some Aspects of Slag Control in Melting Practice," by R. Hay, Ph.D., F.I.C., J. M. FERGUSON, Ph.D., and J. WHITE, Ph.D., A.R.T.C.

Lancashire District.—"Open-Hearth Steelmaking as Practised at the Irlam Works of the Lancashire Steel Corporation, Limited," by J. SINCLAIR KERR, J. V. MORGAN, W. GOLDSBROUGH and D. BINNIE; "The Barrow Hematite Steel Company, Limited," by J. W. DANKS and V. W. DAVISON.

Lincolnshire District.—"The Steel Plants of the Frodingham District, Scunthorpe, Lincolnshire," by J. B. R. BROOKE, A.M.Inst.C.E., S. R. ISAAC and A. ROBINSON; "The Appleby-Frodingham Steel Company's Melting Shops," by A. ROBINSON; "John Lysaght, Limited, Normanby Park Steelworks, Scunthorpe," by J. B. R. BROOKE, A.M.Inst.C.E.; "The Redbourn Works Melting Shop of Messrs. Richard Thomas & Company, Limited," by S. R. ISAAC.

North-East Coast District.—"Acid and Basic Open-Hearth Practice on the North-East Coast," by FRANK BAINBRIDGE, W. GEARY, JAMES WINTER and P. W. WOOD; "Practice at the Works of the South Durham Steel & Iron Company, Limited, and Cargo Fleet Iron Company, Limited," by JAMES WINTER, in collaboration with the melting shop managers and staffs of the Cargo-Fleet, South-Durham Group; "Open-Hearth Acid and Basic Processes at Consett," by P. W. WOOD; "Plant and Practice at Works of Messrs. Dorman, Long & Company, Limited," by W. GEARY, L. E. CROOKS and E. DREWERY; (1) "The Acklam Melting Shop," by W. GEARY and L. E. CROOKS; (2) "Cleveland North Plant," by W. GEARY; (3) "Redcar Steel Plant," by E. DREWERY; "The Melting Shop of the Skinningrove Iron Company, Limited," by FRANK BAINBRIDGE.

Sheffield District.—"Acid Siemens Open-Hearth Process," by E. DAWTRY, W. H. HATFIELD, F.R.S., D.Met., and C. W. WRIGHT; "Making Basic Open-Hearth Steel for Many Purposes," by R. PERCIVAL SMITH; "Basic Open-Hearth Steelmaking Practice of the Park Gate Iron & Steel Company, Limited, Rotherham," by R. T. LINTERN and R. A. HACKING; "Some Experiences in the Design and Control of Open-Hearth Furnaces," by R. J. SARJANT, D.Sc., and E. J. BARNES; "Steelworks Refractories," by T. SWINDEN, D.Met., and J. H. CHESTERS, Ph.D., B.Sc.

South Wales District.—"The Mixed-Gas Melting Shop of Guest Keen Baldwins, East Moors, Cardiff," by JAMES A. DAVIES; "A Tilting Furnace Fired with Cold Coke-Oven Gas," by R. W. EVANS, B.Met.; "The Application of Physical Chemistry to Steelmaking," by A. MCCANCE, D.Sc.; "British Open-Hearth Data and their Correlation," by the Open-Hearth Committee of the Iron and Steel Industrial Research Council.

Discussions.—"British Open-Hearth Data and their Correlation"; "Refractories"; "Fuel"; "Furnace Design and Control"; "Pit-Side Practice"; "Basic Steelmaking"; "Acid Steelmaking"; "Metallurgy and Physical Chemistry of Steelmaking."

The price per volume is 10s. post free. Members and Associates of the Iron and Steel Institute are entitled to one free copy in respect of their membership for the year 1938. A rebate of 20 per cent. will be allowed on orders for ten or more copies to be sent to the one address. Orders should be addressed to the Secretary of the Iron and Steel Institute, 4, Grosvenor Gardens, London, S.W.1.

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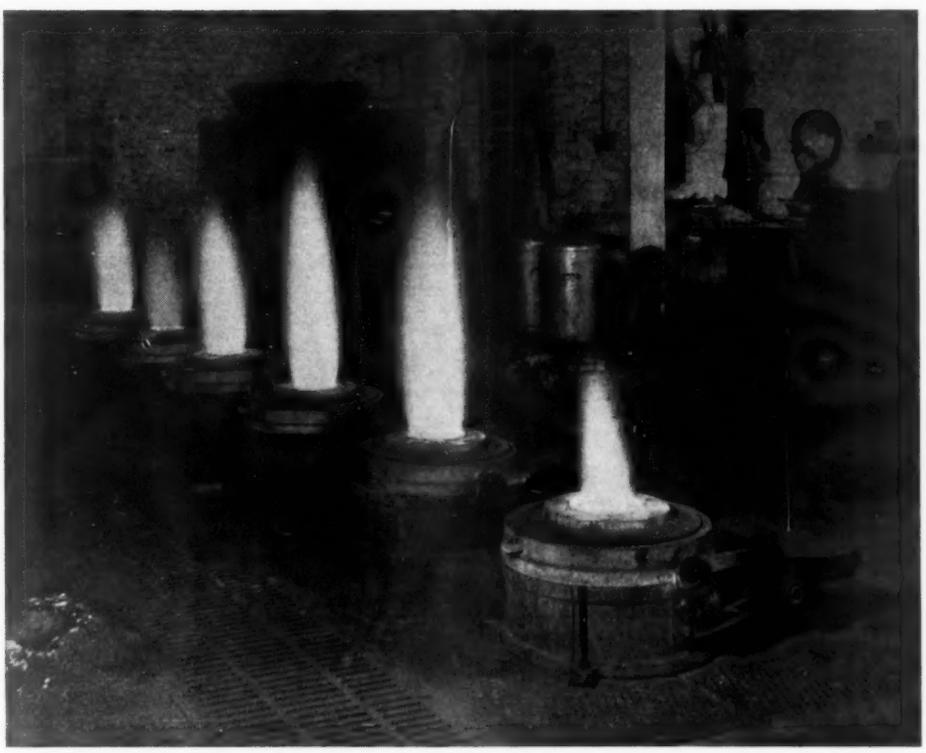

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The Week's News in Brief

Trade Talk

THE 1939 CONVENTION of the American Foundrymen's Association will be held in Cincinnati from May 15 to 18. There will be no exhibition.

THE FORMER American cargo liner "Walden" (3,397 tons) was beached on October 22 at the shipbreaking yard of P. & W. MacLellan, Limited, Carriden, Bo'ness.

THE CUNARD WHITE STAR LINER "Berengaria," of 52,101 tons gross, which has been laid up at Southampton since March last, is to be broken up, and offers are now being invited for that purpose.

THE BRIGHTSIDE FOUNDRY & ENGINEERING COMPANY, LIMITED, Sheffield, has received from the Northern Aluminium Company, Limited, orders for considerable extensions to its Banbury works.

BAIRDS & DALMELLINGTON, LIMITED, have placed an order with the Coppée Company (Great Britain), Limited, for a washery treating 140 tons per hr., complete with slurry flocculation and filtration plant.

A WEST BROMWICH FIRM has purchased the extensive premises at the rear of the Shropshire Iron Company's forge at Trench, near Hadley, Salop. It is understood that an iron foundry is to be started there. Workmen are at present engaged in dismantling the old structures.

JAMES BOOTH & COMPANY (1915), LIMITED, manufacturers of duralumin and other light aluminium alloys have acquired about 31 acres of freehold land from the Birmingham Corporation, situated at Kitt's Green, on the outskirts of Birmingham. The company proposes to erect factory buildings for the production of light alloys to meet the increasing demand.

THOMAS HILL-JONES, LIMITED, Invicta Works, Bow Common Lane, London, E.3, have purchased the old-established business of coal-dust grinding and foundry facings of Mr. Samuel Oliver, of Trafalgar Street, Walworth, London, S.E.17. The Oliver concern has been established over a hundred years. Business communications should be now addressed to Invicta Works.

A 9,500-TON MOTOR-SHIP is to be built by Swan, Hunter & Wigham Richardson, Limited, of Wallsend, for Norwegian owners. The firm will also supply the machinery. This is the first order, apart from naval work, which has been booked on the Tyne for several months. An order for a steamer of 10,000 tons has been placed with William Gray & Company, Limited, West Hartlepool, by a London firm.

A BRONZE PLAQUE to the memory of Mr. William Ross Lane, founder of Lane & Girvan, Limited, ironfounders, of Bonnybridge, was unveiled in the firm's office recently, by Mr. T. L. Elliot, a director. The inscription on the plaque reads:—"In affectionate remembrance of William Ross Lane, who founded the business of Lane & Girvan, Limited, Caledonia Stove and Iron Works, Bonnybridge, in 1904, and was chairman of the company until he died at his residence, Hazelwood, Bridge of Allan, on January 15, 1937."

THE COMMISSIONER FOR SPECIAL AREAS in England and Wales announces that the total commitments at the end of September, 1938, in respect of all the Areas were approximately as follow: (1) Grants to assist industry, £5,152,000; (2) grants for land settlement, etc., £3,260,000; (3) grants towards the cost of schemes urgently necessary in the interests of public health, £6,045,000, and (4) other grants, £2,313,000, making a total of £16,770,000. The total expenditure involved, excluding the capital brought into the Areas by new firms being established on the Trading Estates and elsewhere, was more than £22,500,000.

THE BOARD OF DIRECTORS of Colvilles, Limited, in order to commemorate the honour which their Majesties the King and Queen bestowed upon the company by visiting Clydebridge Steel Works in May of this year, have offered to the Royal Infirmary, Glasgow, a sum up to £10,000 for the establishment and equipment of a Rehabilitation or "Fracture" Clinic for the benefit of employees of Colvilles, Limited, and of other workers who have the misfortune to suffer injuries of types suitable for treatment in such a clinic. This offer has been gratefully accepted by the Governors of the Royal Infirmary. We understand the King has very cordially approved of the provision of this Fracture Unit being associated with the royal visit, and has suggested that a plaque should be incorporated in the completed clinic to record the fact.

Personal

MR. T. NIMMO DEWAR, the first President of the South African Branch of the Institute of British Foundrymen, has arrived in England.

CAPT. JOHN BARROW, chief accountant with the Consett Iron Company, Limited, has retired after 50 years' service. He has been presented with a silver tea service and inscribed salver in appreciation of his services.

MR. WILLIAM WATCHORN has received a presentation to mark his completion of 40 years' service with the firm of Goodwin, Barsby & Company, Limited, ironfounders and engineers, of Leicester. Mr. Watchorn has been foreman of the machine shop for 38 years.

TO MARK THE OPENING of the welfare centre at the works of Aveling-Barford, Limited, Grantham, a presentation was made on October 21 to Mr. Edward Barford, chairman and managing director of the firm. The gift, which had been subscribed for by the whole of the employees at the works, was a table decoration consisting of six silver eagles on a wooden stand. The presentation was made by Mr. Howlett, the works manager.

AT A MEETING held recently in Warsaw, Mr. J. E. Hurst (Past-President of the Institute of British Foundrymen) was elected active President of the International Committee for Testing Cast Iron. This Committee, which is comprised of representatives of foundry technical associations in most European countries and the United States of America, works in conjunction with the International Association for Testing Materials. Whilst Prof. Portevin, the distinguished French metallurgist, is Honorary President, the future work of the Committee will be under the direction of Mr. Hurst, who was preceded in this office by Mr. J. Léonard, of Belgium. Mr. Hurst is technical director of Sheepbridge Stokes Centrifugal Castings Company, Limited, Chesterfield, and of Bradley & Foster, Limited, of Darlaston, and is one of Britain's leading authorities on the metallurgy of cast iron.

Obituary

THE DEATH has taken place at Sunderland of Mr. George Henry Stephenson (59), manager of the forge department of the Sunderland Forge & Engineering Company, Limited.

WE REGRET to learn of the death of Mrs. R. A. Jones, wife of Mr. R. A. Jones, immediate Past-President of the Lancashire Branch of the Institute of British Foundrymen.

WE REGRET to announce the death of Sir Robert Mond, who died in Paris on October 22. During his early years, Sir Robert collaborated with his father, Dr. Ludwig Mond, in discovering the gaseous metallic compound nickel carbonyl and in investigating its properties. It will be remembered that this work led to the Mond carbonyl process of refining nickel. After the death of Dr. Ludwig Mond in 1910, Sir Robert continued his studies of the metallic carbonyls, and he later perfected methods for the industrial production of iron carbonyl. He and his assistants also discovered the first derivative of a metallic carbonyl (cobalt nitrosocarbonyl) and a new ruthenium carbonyl. As chairman of the Mond Nickel Company in 1919, Sir Robert was primarily responsible for initiating the enterprise of separating and refining the platinum metals from the end products of the Mond carbonyl process. In addition to his metallurgical researches, Sir Robert possessed the rare attribute of a trained scientific approach to the problems of everyday life. His thirst for accurate knowledge was immense, and he applied his talents to the widest possible range of arts and sciences. He made a particular study of agriculture and, in his laboratory, bacteriological and chemical examinations on all the various products of his firm were continuously carried out. Almost every phase of chemistry, physics, and electromagnetic phenomenon attracted him, and whenever possible key experiments to check up on published data were carried out in his laboratories. Amongst his other interests was the study of archæology, and he gained a well-merited reputation as an archæologist and antiquarian. His many personal kindnesses and his tireless encouragement of young research and industrial workers will make his loss keenly felt in a wide sphere of scientific activity.

Company Reports

Anglo-Greek Magnesite Company, Limited.—Interim dividend of 3 per cent.

Broken Hill Proprietary Company, Limited.—Half-yearly dividend of 1s. 3d. (Australian currency) on the fully-paid shares.

Wombwell Foundry & Engineering Company, Limited.—Profit for the year ended July 31, £14,454; brought in, £4,272; to depreciation reserve, £2,020; taxation, £4,325; taxation reserve, £3,000; dividend of 10 per cent.; carried forward, £4,668.

Herbert Morris, Limited.—Profit for the year ended July 31 last, after income tax and N.D.C., £202,445; interest and dividends on investments, etc., £881; brought in, £50,224; available after fees, preference dividend for year, interim ordinary dividend of 5 per cent. and depreciation, £200,367; further dividend on the ordinary shares of 27½ per cent. actual (free of tax); to reserve, £20,000; carried forward, £70,367. Meeting, October 28.

Contracts Open

Manchester, November 4.—Malleable iron fittings and cast-iron pipes, for the Gas Committee. Mr. J. H. Cadman, commercial manager, City of Manchester Gas Department, Town Hall, Manchester 2.

Alexandria, November 12.—Machinery and plant, for the Egyptian Ministry of Communications. (D.O.T. reference: T.Y. 27,804/38.)

Esher, November 7.—Provision and laying of 670 yds. of 27 in. dia. cast-iron sewers, 631 yds. of 24 in., 1,710 yds. of 18 in., 362 yds. of 16 in., 1,452 yds. of 15 in., 1,678 yds. of 12 in., 1,810 yds. of 9 in., 2,153 yds. of 7 in., for the Urban District Council. Mr. H. C. Fread, engineer, Council Offices, Esher. (Fee £5 5s., returnable.)

New Company

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

James Day (Machinery), Limited.—Capital £1,500. Brass, bronze and iron founders, etc. Directors: J. Day, 9, Barnhill Road, Wembley Park, Middlesex; and W. E. Jackson.

Forthcoming Events

NOVEMBER 1 AND 2.

Institution of Gas Engineers:—Tenth autumn research meeting, at Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, at 10 a.m. and 2.30 p.m. each day.

NOVEMBER 3.

Institute of Metals (Birmingham Section):—"Training of the Metallurgist," open discussion, at James Watt Memorial Institute, at 7 p.m.

Keighley Association of Engineers:—Joint meeting with Institute of Welding (Leeds Branch): "Oxy-Acetylene Welding of Cast Iron," by E. Ryalls, and "Electric Welding of Large Castings," Paper by A. J. Davies, at Victoria Hotel, Keighley, at 7.30 p.m.

Institute of British Foundrymen

NOVEMBER 2.

London Branch:—"What We Do Not Know About Cast Iron," Paper by J. E. Hurst, at Charing Cross Hotel, London, W.C.2, at 8 p.m.

NOVEMBER 3.

Sheffield Branch:—Apprentice patternmakers' competition, and smoking concert, at Royal Victoria Hotel, Sheffield, at 7.30 p.m.

NOVEMBER 4.

Birmingham, Coventry and West Midlands Branch:—"Chilled Iron and Other Rolls," Paper by A. Allison at James Watt Memorial Institute, Birmingham, at 7.30 p.m.

Lincolnshire Section:—Joint meeting with Lincoln Engineering Society: "Recent Improvements in Cast Iron," Paper by J. E. Hurst, at Lincoln Technical College, at 6.45 p.m.

NOVEMBER 5.

Falkirk Section:—"Facings in Use in the Modern Foundry," Paper by H. Winterton, at Temperance Café, Lint Riggs, Falkirk, at 6 p.m.

Lancashire Branch:—"Foundry Drying and Modern Core Shop Lay-out," Paper by W. H. Smith, at Engineers' Club, Manchester, at 4 p.m.

Wales and Monmouth Branch:—Discussion on "Some Faulty Castings," at University College, Cardiff, at 6 p.m.

The Institute of Vitreous Enamellers

OCTOBER 28-30.

Fifth Annual Conference:—At Hotel Normandie, Knightsbridge, London, S.W.1.

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Raw Material Markets

Further indications that many consumers of both iron and steel are drawing near to the end of their stocks have been forthcoming this week. However, until prices for delivery after the turn of the year are made known, business will be confined to small parcels for delivery before December 31. The outlook is brighter and, apart from normal commercial demands, no doubt the requirements of the armament programme will continue to increase.

Pig-Iron

MIDDLESBROUGH.—Deliveries of foundry iron are being called for at a good rate and many contracts have already expired. Forward business is not now being arranged, as consumers are reluctant to engage themselves ahead until next year's quotations have been fixed. It is generally anticipated that the new rates will be in buyers' favour. It seems fairly certain that there will have to be an increase in the production of foundry iron, as a considerable expansion in trade is likely to occur early in the new year. Although the hematite trade is now a little brighter, the call for deliveries being more insistent, business remains rather unsatisfactory. In many cases consumers have still heavy tonnages to take up before contracts expire and new business can be considered. Fortunately, some business, small as it is, has been negotiated with overseas consumers and it is hoped that this section will continue to improve, as the loss of export orders has been seriously felt.

LANCASHIRE.—A further slight improvement may be noted in the foundry iron trade of this area. The call for deliveries has been better, but any new orders are limited to small parcels for early delivery, users preferring to await the announcement of future prices before committing themselves. Local foundries are rather more active and report that inquiries are coming to hand more freely, but still more orders would be welcomed.

MIDLANDS.—High-phosphorus iron is now moving away in heavier tonnages. The expansion of business is due to the fact that stocks have been brought down to a reasonable level. For many months past consumers' stocks have been much too unwieldy to allow them to take up additional supplies. Nevertheless, it cannot be said that trade among consumers has increased to any great extent, although there has been an upward trend. The furnaces are able easily to meet current demands without increasing production. Business in low-phosphorus iron is still further increasing; owing to the doubts surrounding the trend of future prices, users are refraining from booking too far ahead, although it is not expected that there will be any substantial reduction in the quotation, which at present varies, according to quality and tonnage, from £5 10s. to £6 per ton. Hematite deliveries are being made more freely, although consumers have still heavy supplies outstanding under contracts. However, this section is likely to improve still further under the influence of the rearmament programme.

SCOTLAND.—Little change occurs in the pig-iron market from week to week, consumers continuing to take up small tonnages as and when required. No. 1 foundry iron is quoted at 120s. 6d., with No. 3 at 118s., f.o.t. furnaces. Short-time working is still prevalent among light-castings foundries and there are no prospects of any real improvement in this respect. Hematite mixed numbers are quoted at 133s., Scottish basic 107s. 6d., and English and Indian basic 100s., less 5s. rebate, delivered steelworks. There is little change in conditions among local steelmakers.

Coke

In view of the fact that no changes are expected to be made in prices of foundry coke, at least before the end of the year, ironfounders are calling for substantial quantities. Many of the producers are unable to give early delivery, but this is not as yet causing much inconvenience, as the coke is generally needed for stocking purposes and not for immediate requirements. Orders from abroad have also been much heavier during the past few weeks. For delivery to Birmingham and Black Country stations, best Durham coke is quoted at 50s. 6d. per ton, while Welsh coke is quoted at a minimum of that figure.

Steel

The volume of business in the steel market remains disappointing, and, although occasionally there appears to be some improvement in the tonnage changing hands, consumers in all departments are pursuing a cautious policy. Consumers of semi-finished steel have shown more interest in the market than for some time, although a considerable amount of business passing has been in special quality steels. Production in this department, however, is still restricted, but imports of Continental material have been limited during recent months. In the finished steel market, conditions have improved, and there is a more general inclination noticeable to undertake forward commitments. This movement, so far, has been confined to a few departments, but it has imparted a better tone to the market. Business on oversea account has consisted of comparatively small parcels, but the volume of inquiry has shown signs of expansion.

Scrap

There has been a surprisingly good demand for cast-iron scrap during the past week or so and prices have moved up in consequence. In fact, merchants are holding out for still higher levels. Steel scrap, however, continues to be in very restricted demand and deliveries are still on the small side.

Metals

Copper.—The outlook for this metal appears to be quite satisfactory and the tone of the market remains firm. Stocks are by no means high and statistically the position of this metal is better than it has been for a considerable time past. Now that restriction on production has been scrapped producers may take the opportunity to build up stocks. So long as this is carried out within reasonable limits there should be little risk of damaging the position. Further, the consumption of the metal is expected to expand still more, especially as the needs of the armament makers are rising.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £46 1s. 3d. to £46 3s. 9d.; Friday, £45 10s. to £45 12s. 6d.; Monday, £46 3s. 9d. to £46 6s. 3d.; Tuesday, £46 7s. 6d. to £46 8s. 9d.; Wednesday, £46 17s. 6d. to £46 18s. 9d.

Three Months.—Thursday, £46 5s. to £46 6s. 3d.; Friday, £45 15s. to £45 17s. 6d.; Monday, £46 8s. 9d. to £46 10s.; Tuesday, £46 11s. 3d. to £46 12s. 6d.; Wednesday, £47 2s. 6d. to £47 3s. 9d.

Tin.—It is somewhat surprising that prices have been so well maintained recently, as there is little indication that consumers have any desire to re-enter the market for substantial tonnages. The weekly market report issued by Rudolf Wolff & Company, states that "trade demand has slackened a little and rather less activity is reported with consumers in this country and on the Continent, as, also, in the United States. The London market has at no time presented any very definite tendency and prices have fluctuated largely in accordance with outside influences and in sympathy with the general tone prevailing. The hesitant tone of the market in the last day or two was largely in sympathy with the unsettled conditions prevailing in other markets, where the higher levels reached brought out a certain volume of selling and realisation, in face of which buyers were inclined to adopt a reserved attitude pending fresh developments with regard to both the industrial and political outlook."

Official quotations were as follow :—

Cash.—Thursday, £208 15s. to £209; Friday, £208 5s. to £208 10s.; Monday, £210 15s. to £211; Tuesday, £210 15s. to £211 5s.; Wednesday, £212 to £212 10s.

Three Months.—Thursday, £209 15s. to £210; Friday, £209 5s. to £209 10s.; Monday, £211 15s. to £212; Tuesday, £212 to £212 5s.; Wednesday, £213 5s. to £213 7s. 6d.

Spelter.—Trade demand generally has been rather quiet, but the call for supplies from armament concerns continues to account for a good turnover. It is understood that the proposals regarding zinc import duties at present under consideration by the Import Duties Advisory Committee provide that the present import duty of 12s. 6d. per ton on foreign metal be increased to 30s. per ton. Empire zinc would remain on the free list, but the premium of 12s. 6d. per ton over the London Metal Exchange contract at present payable by Empire buyers would be raised to 30s. per ton. Importers of Empire zinc would pay 10s. per ton on such imports to the Imperial Smelting Corporation, Limited, and a further 5s. per ton into a pool, while Imperial Smelting would also pay 5s. per ton into the same pool for every ton of metal which it produces. This pool would be used to subsidise exports.

Daily market prices :—

Ordinary.—Thursday, £15 5s.; Friday, £15 2s. 6d.; Monday, £15 6s. 3d.; Tuesday, £15 8s. 9d.; Wednesday, £15 8s. 9d.

Lead.—A quieter tone has prevailed in this market during the past few days. Much of the recent speculative support appears to have been withdrawn. But, on the whole, the outlook is satisfactory and there should be some good business placed when prices become more stable, as rising quotations have tended to disinterest consumers, who are now only buying for their immediate needs. The Ministry of Labour announces that the cost of buildings plans approved in September fell by 25.1 per cent. compared with September last year. This is much larger than the average fall during this year and follows a rise of about 9 per cent. in August. A substantial decline, however, was expected last month in view of the uncertainties and dislocation arising from the political crisis. For the first nine months of this year plans approved totalled £74,750,000, against £83,712,000 for the corresponding period of last year, a decline of 10.7 per cent.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £16 5s.; Friday, £16; Monday, £16 2s. 6d.; Tuesday, £16 7s. 6d.; Wednesday, £16 12s. 6d.

Scrap.—Most descriptions of non-ferrous scrap have recently been in quite good demand. Exceptions have been heavy brass and gunmetal which are still difficult to dispose of.

Approximate selling prices for old metal:—New aluminium cuttings, £68; rolled, £54; cast, £30; foil, £80. Copper, £39 to £44; braziery, £35. Brass (clean), £22 to £24. Zinc, £11. Lead, £14 10s. Gunmetal, £40.

London Engineering Works Extension

For the fourth time during the last ten years, G. A. Harvey & Company (London), Limited, have found it necessary to make a considerable addition to their works at Woolwich Road, Charlton, S.E.7, and the latest extension brings the total area covered by their works up to 25 acres. The new building, which is nearing completion, is a reinforced concrete structure of five storeys, 152 ft. long, 92 ft. wide, and 72 ft. 9 in. in height to the top of the parapet, with a total floor area of about 70,000 sq. ft. The four upper floors are to be allocated to a much needed expansion of the firm's steel equipment department and will be devoted entirely to the manufacture of steel filing cabinets and other forms of steel office furniture. The ground floor is to be utilised for the baling and despatch of scrap metal. A railway siding connects the new building with the Southern Railway system and with a wharf on the River Thames.

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